PACIFIC SALMON COMMISSION
JOINT CHUM TECHNICAL COMMITTEE

2012 POST SEASON SUMMARY REPORT

TCCHUM (15) –1

May 2015

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Mr. John Candy, CDFO	Mr. Jay Zischke, Co-Chair, Suquamish Indian Tribe
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Mr. Joe Tadey, CDFO	Dr. Maureen Small, WDFW
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Mr. Joe Tadey, CDFO	Dr. Gary Winans, NOAA
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LIST OF ACRONYMS WITH DEFINITIONS

B.C.	British Columbia
CDFO	Canadian Department of Fisheries and Oceans or Fisheries and Oceans Canada
CPUE	Catch per Unit Effort
CU	Conservation Unit (Canada)
CWT	Coded-Wire Tag
ECVI	East Coast Vancouver Island
EO	Economic Opportunity
ESSR	Excess Salmon to Spawning Requirements
ESU	Evolutionarily Significant Unit
FN	First Nation
FN FSC	First Nations Food, Social and Ceremonial
FSC	Food, Social, and Ceremonial (Canada)
GN	Gill net
GSI	Genetic Stock Identification
ITQ	Individual Transferable Quota
mtDNA	Mitochondrial DNA
mSAT	Microsatellite DNA
NOAA	National Oceanic and Atmospheric Administration
NWIFC	Northwest Indian Fisheries Commission
PFMA	Pacific Fishery Management Area
PNPTC	Point No Point Treaty Council
PSC	Pacific Salmon Commission
PST	Pacific Salmon Treaty
SJF	Strait of Juan de Fuca
SJI/PR	San Juan Islands/Point Roberts
SN	Seine net
SNPs	Single-Nucleotide Polymorphisms
TCCHUM	Chum Technical Committee
TR	Troll
U.S.	United States of America
WA	Washington State
WCVI	West Coast Vancouver Island
WDFW	Washington Department of Fish and Wildlife
WSP	Wild Salmon Policy (Canada's Policy for Conservation of Wild Pacific Salmon)

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1 Executive Summary

This Pacific Salmon Commission (PSC) Joint Chum Technical Committee report presents the information on Chum salmon stocks and fisheries in southern British Columbia (B.C.) and Washington (WA) for the year 2012 to address the specific provisions and requirements of Chapter 6, Annex IV (Chum Annex) of the Pacific Salmon Treaty (PST or Treaty) (Appendix A). The Treaty between the governments of Canada and the United States of America (U.S.) concerning Pacific salmon is designed to facilitate co-operation in the management, research and enhancement of Pacific salmon stocks. The Chum Annex requires that Canada and the U.S. maintain a Joint Chum Technical Committee reporting to the Southern Panel and the Commission and that certain fisheries for Chum salmon in southern B.C and WA be managed in a specified manner (Appendix A). Certain fisheries of each country, while not specifically mentioned in the PST, are known to harvest Chum salmon originating in the other country.

This report presents various aspects of Chum salmon found in B.C. waters between Vancouver Island and the mainland, off the west coast of Vancouver Island, and in WA waters. This report also discusses the management actions of Canada and the U.S. in relation to the PST requirements for Chum salmon and provides a summary of the last 10 years of catch and escapement information for Chum salmon of concern to the Treaty. Returns in 2012 were average in B.C. to slightly below recent 9-yr average in WA.
The Chum Technical committee began developing proposals to address components of the strategic plan outlined in the 2010 report. The components included collecting and exchanging tissue samples from boundary area populations for the Chum salmon genetic baseline, organizing a series of meetings to present the Chum Technical committee vision to agencies, managers and samplers, as well as continuing mixed stock fishery sampling in key regions.

2 Status of Treaty Requirements

Chum salmon stocks and fisheries in southern B.C. and in U.S. Areas 4B, 5, 6C, 7, and 7A (Appendix B) were managed under the terms set out in Chapter 6, Annex IV (Appendix A). The following provides a brief synopsis of the Canadian and U.S. management actions taken to meet its provisions in 2012.

Paragraph 1:

> *The Parties were to maintain a Joint Chum Technical Committee ("*the Committee"*) reporting, unless otherwise agreed, to the Southern Panel and the Commission. [Specific tasks for the Committee are listed in Annex IV Chapter 6, Paragraph 1. Some of these include review stock status, develop new methods for stock management and report on management and research findings.]*

The Committee convened two times in 2012: during the PSC Post-Season Meeting in January, during the PSC 25th Annual Meeting in February, and for additional work in Laconnor, WA, in May. In 2010 the committee developed a strategic plan to guide development and application of a jointly agreed genetic baseline for Chum salmon stocks in southern BC and Washington and eventual development of the Chum Genetic and Environmental Model (ChumGEM) (Figure 2-1). The committee also completed three proposals for submission to the PST Southern Boundary Restoration and Enhancement Fund (Southern Fund) to carry forward the first three priorities in this strategic plan. Additional detail of the work performed by the Committee in 2012 can be found in the Committee's 2012-2013 Work Plan (Appendix C).

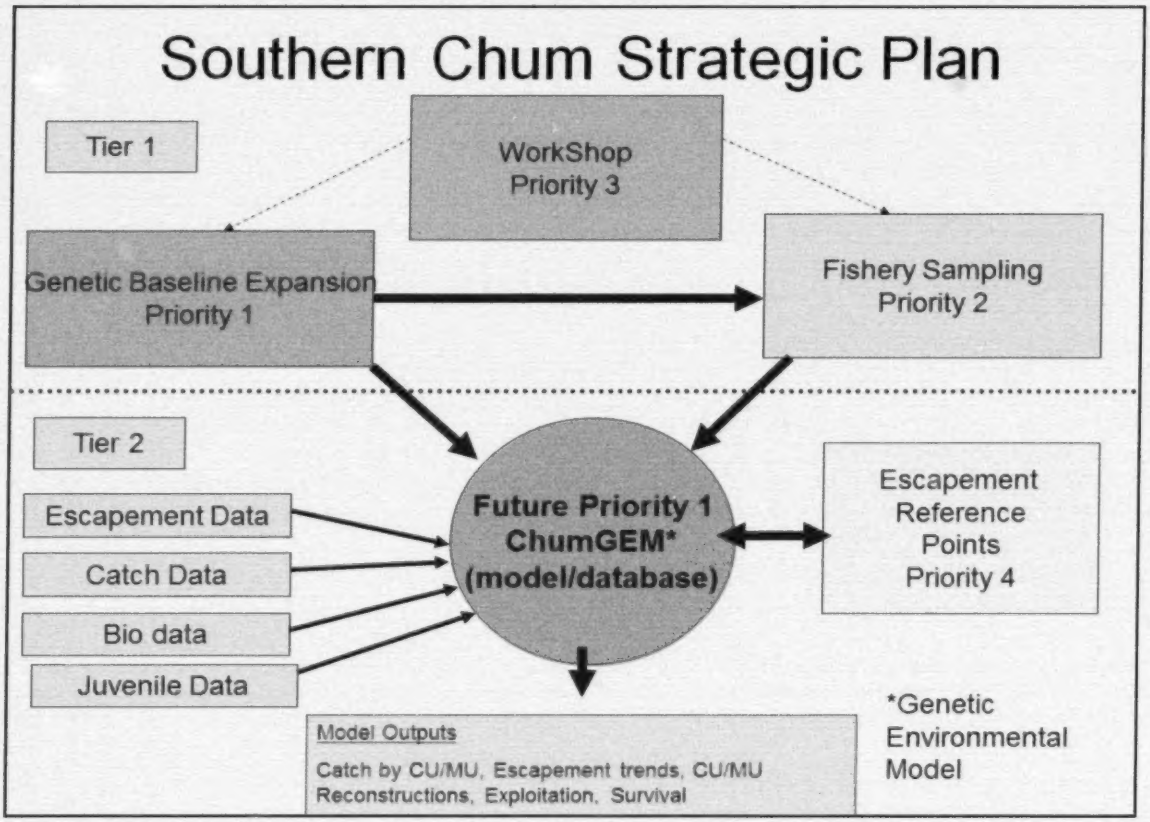

Figure 1-2 Southern Chum Strategic Plan developed by the joint Chum Technical Committee in 2012.

Paragraph 2:

> *When the Parties provide stock composition information for fisheries, the Committee shall evaluate and report its conclusions using bilaterally agreed upon methods.*

For this report, the Committee continued to use historical stock composition information to estimate Chum salmon stock composition for 2012 fisheries. These historical stock composition estimates may no longer be representative of current stock composition, and the Committee is continuing to evaluate and implement new methods following the Committee's Strategic Plan (Figure 2-1) of which improved stock identification methodologies play a significant role. The initial stages of this Strategic Plan have been implemented and work on the development and implementation of the final stage of the plan is ongoing.

Paragraph 3:

> *Canada and the United States shall assess catch levels and make attempts to collect additional genetic samples from any Chum salmon caught during the July 1 through September 15 time period in the boundary area fisheries (U.S. Areas 4B, 5, 6C, 7 and 7A; Canadian Areas 18, 19, 20, 21, and 29).*

Table 3-4 and Table 4-4 provide the harvest of Chum salmon during the period of summer Chum salmon migration in boundary areas. Due to the low numbers of Chum salmon encountered, neither party collected samples for genetic stock identification (GSI) during this time period.

Paragraph 4:

> *During the period from July 1 through September 15, Canada will require the live release of Chum salmon from all purse seine gear fishing in the Strait of Juan de Fuca (Canadian Area 20) and the United States will require the same for the non-Indian seine fisheries in Areas 7 and 7A. Note: By U.S. regulation, purse seine fisheries are not permitted in U.S. Areas 4B, 5 and 6C.*

Regulations were implemented by both countries to require the live release of Chum salmon in these areas during this time period.

Paragraph 5:

> *Canada will manage its Johnstone Strait, Strait of Georgia, and Fraser River Chum salmon fisheries to provide continued rebuilding of depressed naturally spawning Chum salmon stocks, and, to the extent practicable, not increase interceptions of U.S. origin Chum salmon. Terminal fisheries conducted on specific stocks with identified surpluses will be managed to minimize interception of non-targeted stocks.*

Table 3-1 provides an evaluation of the performance of the current Johnstone Strait management strategy (2003–2012). Historical GSI results and genetic estimates from 2006 through 2012 continued to indicate a low contribution of U.S. stocks in Johnstone Strait, Strait of Georgia and Fraser River Chum salmon fisheries.

Management strategies (see section 3.3) and annual fishery descriptions (see section 3.4) indicate that Canada's Johnstone Strait, Strait of Georgia, and Fraser River Chum salmon fisheries in addition to the terminal area fisheries, were managed to meet the provisions of Paragraph 5 of Annex IV, Chapter 6, of the PST.

Paragraph 6:

> *Canada will manage its Johnstone Strait mixed stock fishery as follows:*
>
> *a) Inside Southern Chum salmon levels of less than 1.0 million as estimated by Canada are defined, for purposes of this chapter, as critical.*
>
> *b) For run sizes above the critical threshold, Canada will conduct fisheries with an exploitation rate of up to 20% in Johnstone Strait of Inside Southern Chum salmon; and*
>
> *c) When run sizes are expected to be below the critical threshold, Canada will notify the United States and will only conduct assessment fisheries and non-commercial fisheries. Commercial fisheries targeting Chum salmon will be suspended.*

While no specific estimates of Inside Southern Chum salmon abundance were provided, Canada notified the U.S. in early October, on the basis of inside area fisheries, the return abundance of Inside Southern Chum salmon was likely above the critical threshold. Canada continued to manage the Johnstone Strait fisheries to target to 20% of Inside Southern Chum.

Paragraph 7:

Canada will manage its Fraser River fisheries for Chum salmon as follows:

a) For Fraser River terminal area run sizes, identified in-season, at abundance levels lower than 900,000 Chum salmon, the Canadian commercial Chum salmon fisheries within the Fraser River and in associated marine areas (Area 29), will be suspended; and

b) For Fraser River terminal area run sizes, identified in-season at levels greater than 900,000 Chum salmon, Canadian commercial Chum salmon fisheries within the Fraser River, shall be guided by the limits of the in-river Total Allowable Catch set by Canada.

In 2012, initial in-season abundance estimate on October 16 indicated a terminal return above the specified Fraser River gross escapement threshold (see section 3.4.3). There was an additional run size update on October 22 to 2,326,000 and October 24 to 2,253,000 for Fraser River Chum salmon. That increase in estimated abundance allowed the prosecution of an in-river Area E gillnet fishery on October 25, and an Area B seine fishery October 27 and 28.

Paragraph 8:

Canada will manage the Nitinat gill net and purse seine fisheries for Chum salmon to minimize the harvest of non-targeted stocks.

In 2012, in-season assessment information indicated the Nitinat return was sufficient to initiate commercial fisheries. As a result, commercial gill net and purse seine fisheries in Area 21 occurred in 2012 (see section 3.4.4.1; Table 3-10). To minimize the harvest of non-targeted stocks a variety of management actions were applied to the Nitinat fishery (see section 3.3.4.1)

Paragraph 9:

Canada shall conduct a genetic sampling program of Chum salmon taken in the West Coast Vancouver Island troll fishery if early-season catch information indicates that catch totals for the July 1 through September 15 season may reach levels similar to 1985 and 1986. Sampling, should it occur, will include catches taken from the southern areas (Canadian Areas 121–124).

Chum salmon catch levels in the 2012 West Coast Vancouver Island troll fishery were significantly below the 1985 and 1986 levels. Therefore, no GSI sampling occurred.

Paragraph 10:

The United States will manage its Chum salmon fishery in Areas 7 and 7A as follows:

a) Inside Southern Chum salmon levels of less than 1.0 million as estimated by Canada are defined, for purposes of this chapter, as critical;

b) For run sizes below the critical threshold, the U.S. catch of Chum salmon in Areas 7 and 7A shall be limited to Chum salmon taken incidentally to other species and in other minor fisheries, but shall not exceed 20,000, provided that catches for the purpose of genetic stock identification sampling shall not be included in the aforementioned limit;

c) For run sizes above the critical threshold, the base catch ceiling for the U.S. Chum salmon fisheries in Areas 7 and 7A will be 130,000 Chum salmon;

d) Canada will provide a run size estimate of Chum salmon entering the Fraser River no later than October 22. If the estimate is less than 900,000, the U.S. will limit its fishery impacts on

Fraser River Chum salmon by restricting catch in Areas 7 and 7A to not exceed 20,000 additional Chum salmon from the day following the date the U.S is notified. The total catch is not to exceed the catch ceiling of 130,000 Chum salmon;

e) U.S. commercial fisheries for fall Chum salmon in Areas 7 and 7A will not occur prior to October 10;

f) The U.S. will manage the Areas 7 and 7A fisheries for Chum salmon with the intent to minimize the harvest of non-targeted species;

g) No U.S. catch shortfalls may be accrued; however any overages shall be carried forward as indicated in (h) and (i);

h) Due to management imprecision, a catch in the U.S. of up to 135,000 Chum salmon will not result in an overage calculation. Catches in excess of 135,000 Chum salmon shall result in an overage being calculated by subtracting 130,000 from the total Chum catch. Overages will be accounted for by reducing the U.S. annual catch ceiling in up to two subsequent non-critical Inside Southern Chum salmon years; and

i) From the day following the date the U.S. is notified of a run size below the critical threshold as defined in 10(b) or (d), any catches in excess of 20,000 Chum salmon will result in an overage. Overages will be accounted for by reducing the U.S. annual catch ceilings in up to two subsequent non-critical Inside Southern Chum salmon years.

In 2012, U.S. fisheries in Areas 7 and 7A were managed in accordance with the above provisions. U.S. commercial fisheries were initiated as scheduled on October 10. An estimated Fraser River Chum salmon run size was provided by Canada on October 16, with an estimate of 1,900,000. The fishery was therefore continued without restriction through November 14. The U.S. catch between October 10 and November 14 in Areas 7 and 7A was 70,480 Chum salmon. The Non-Treaty gill net and purse seine fleets were open daily October 11, 14, 15, 17, 18, and then continuously October 21 through November 10. The Treaty Indian gill net and purse seine fisheries were opened on October 10, 12, 13, 16, 19, 20, and then ran continuously from October 22 through November 14. Catches per vessel and effort were good throughout the fishery.

The total 2012 Chum salmon catch by all gears and all fisheries (including incidental by-catch) in Areas 6, 7, and 7A was 73,255. Catch distribution, between Areas 7 and 7A, was 64% and 36% respectively.

Paragraph 11:

The United States shall conduct its Chum salmon fishery in the Strait of Juan de Fuca (United States Areas 4B, 5, and 6C) so as to maintain the limited effort nature of this fishery, and, to the extent practicable, not increase interceptions of Canadian origin Chum salmon. The United States shall continue to monitor this fishery to determine if recent catch levels indicate an increasing level of interception.

This fishery is restricted to Treaty Indian fishers from four tribes and to gill net gear only. The Committee has not specifically addressed interception estimates during the 1994 through 2011 time period. Genetic stock identification (GSI) samples collected from this fishery in prior years indicate the majority of the catch is Chum salmon of U.S. origin. Effort in this fishery has remained at historically low levels. Total fall Chum salmon catch during directed fisheries in Areas 4B, 5 and 6C was just 348 fish.

Paragraph 12:

All information concerning by-catch of other salmon species from the Chum salmon fisheries covered by this chapter will be shared between the Parties in the annual Post Season Report.

During the 2012 fall Chum salmon fisheries in Areas 6, 7 and 7A, there was a reported by-catch of 5 Chinook and 9,594 Coho salmon. In the Strait of Juan de Fuca (4B, 5 and 6C) fall Chum salmon fisheries, there was a reported by-catch of 7 Chinook, 672 Coho and one Steelhead.

Paragraph 13:

Should circumstances arise that are inconsistent with either Parties understanding of the intent of the chapter, the Southern Panel will discuss the matter postseason and explore options for taking the appropriate corrective actions.

No such circumstances arose in 2012.

3 Southern British Columbia Chum salmon

3.1 Introduction

Southern B.C. Chum salmon stocks and fishing areas (Pacific Fishery Management Areas or PFMAs; Appendix B) are, for the purposes of management, analysis and reporting, grouped into four major units: Johnstone Strait, Strait of Georgia, Fraser River, and the West Coast Vancouver Island (WCVI). Additionally, Chum salmon originating from Johnstone Strait, the Strait of Georgia, and the Fraser River are collectively described as Inside Southern Chum salmon.

3.2 Status of Treaty Requirements

During 2012, the Southern B.C. Chum salmon fisheries were managed according to the requirements of Annex IV, Chapter 6, as amended in 2009 (Appendix A).

3.3 Conservation and Harvest Management Strategies

The general management approach adopted by Fisheries and Oceans Canada (CDFO) for Southern B.C. Chum salmon is to achieve wild escapement targets, while augmenting production through enhancement of selected stocks. In practice, this approach is achieved through the application, in mixed stock fisheries, of harvest rates which are compatible with wild or natural stock productivity. If there are Chum salmon stocks that return to their area of origin in numbers above that area's escapement goal, they may be subject to additional harvesting within their terminal areas.

The following describes the management strategies and fishing plans for the four units of Southern B.C. Chum salmon stocks

3.3.1 Johnstone Strait Chum Salmon Management Strategy

Since 2002, the mixed stock Chum directed fisheries in Johnstone Strait have been managed to approximate a fixed exploitation rate (~20%). Tagging studies conducted from 2000 through 2002 helped in the development of this fixed exploitation rate strategy by assessing the migration timing and harvest rate by fishing gear on an available abundance of Chum salmon in Johnstone Strait. This fixed exploitation strategy continued to be employed through 2012 (CDFO 2012).

Some of the key objectives of this strategy are to ensure sufficient escapement levels while providing more stable fishing opportunities (CDFO 2012). The exploitation rate is set at 20% across all harvesters, when abundance is estimated to be above a critical level. The critical level, or threshold, was determined to be 1.0 million Chum salmon (Appendix A). The Johnstone Strait Chum salmon test fishery, as well as the information gained from any commercial openings, is used in-season to determine the likelihood of achieving the critical level for Inside Southern Chum salmon. When expected levels are less than 1.0 million, only assessment fisheries and non-commercial fisheries will be conducted and any planned commercial fisheries targeting Chum salmon will be suspended (Appendix A). When the critical level is expected to be achieved, fisheries with an exploitation rate of up to 20% in Johnstone Strait can be conducted (Appendix A).

Of this 20%, the commercial sector is allocated 15%. The remaining 5% is set aside to provide for First Nations' food, social and ceremonial needs (FSC) satisfy recreational and test fishing requirements, and to

provide a buffer to the commercial exploitation (CDFO 2012). The impact of the Johnstone Strait fisheries during fixed exploitation approach (2003–2012), on Inside Southern Chum salmon stocks are detailed in Table 3-1.

The specific objectives of the fixed exploitation rate strategy are to:

- continue to rebuild/maintain stocks to the optimum wild escapement objective (defined as 2.5 million wild Inside Southern Chum salmon);
- establish a pre-season fishing plan to achieve an exploitation rate of 20% on Inside Southern Chum salmon in the Johnstone Strait Chum salmon fishery; and,
- stabilize commercial catch rates to provide opportunities at both low and high abundance levels

Table 3-1. Assessment of the Clockwork (stepped harvest rate) and the current (fixed harvest rate) Johnstone Strait Chum Salmon Management Strategy, 2003–2012

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
PRE-SEASON										
Inside Southern Abundance Forecast (or Outlook)	Below Average	Average	Average	Average	Average to Above Average	Below Average	Below Average	Average to Below Average	Average to Below Average	Average to Below Average
IN-SEASON										
Management Strategy	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed	Fixed
POST-SEASON										
Inside Southern Abundance[2]	3,570,767	5,519,205	3,126,617	4,301,780	2,728,020	2,227,630	2,227,110	1,181,528	3,449,783	3,518,665
Inside Southern Harvest	1,340,850	1,876,239	1,304,237	1,527,453	796,239	579,756	747,043	127,967	1,441,680	911,485
Est. Inside Southern Harvest Rate	37.6%	34.0%	41.7%	35.5%	29.2%	26.0%	33.5%	10.8%	41.8%	25.9%
Johnstone Strait Harvest										
Commercial, Sport Area 11-13[3]	924,505	1,176,611	856,029	859,201	480,620	299,775	513,884	55,520	750,436	392,608
First Nations Area 11-13	14,780	27,041	18,841	16,453	14,870	11,630	13,576	4,060	9,880	13,106
Johnstone Strait Harvest Total	939,285	1,203,652	874,870	875,654	495,490	311,405	527,460	59,580	760,316	405,714
Target Johnstone Strait Harvest Rate	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
Est. Johnstone Strait Harvets Rate	26.3%	21.8%	28.0%	20.4%	18.2%	14.0%	23.7%	5.0%	22.0%	11.5%
ESCAPEMENT (Includes wild and enhanced)[4]										
Inside Southern Escapement	2,229,917	3,642,966	1,822,380	2,774,327	1,931,781	1,647,874	1,480,067	1,053,561	2,008,103	2,607,180

(1) Historic data in this table have been updated with most recent estimates; values may deviate from past reports.
(2) Total Inside Southern abundance includes total Inside Southern harvest plus escapement. Harvest composition based on historic GSI for all fisheries.
(3) Includes commercial, sport and test fishery harvest.
(4) Escapement estimates do not include any removals associated with hatchery rack (e.g. ESSR); those values are included in harvest. Escapement estimates have not been expanded for populations not monitored for escapement

3.3.2 Strait of Georgia Chum Salmon Management Strategy

Chum salmon stocks return to all areas of the Strait of Georgia (mid-Vancouver Island PFMA's 14-19) and are of enhanced and wild (natural) origin. Fisheries can target enhanced returns (e.g. Area 14: Puntledge, Qualicum and Little Qualicum rivers), wild returns (e.g. Area 16: main river systems of Tzoonie, Deserted and Skwawka Rivers in the Jervis inlet area) and mixed returns (e.g. Area 19: directed primarily at enhanced Goldstream River populations although some natural Cowichan River Chum salmon are also harvested).

With one exception, pre-season forecasts of the return of Strait of Georgia Chum salmon for population aggregates corresponding to PFMA's have limited use due to their inability to reasonably predict returns (CDFO 2012). The one exception is Chum salmon returning to Area 14. As a result, unlike some other units of Southern BC Chum Salmon (e.g. WCVI see section 3.3.4), pre-season fishing plans based on a pre-season forecast are not typically developed for Strait of Georgia Chum salmon stocks.

Strait of Georgia Chum salmon are managed as a component of a "mixed-stock harvest strategy" for Johnstone Strait and the northern Strait of Georgia. In-season management of Strait of Georgia Chum salmon is guided by advice from the South Coast Chum Advisory Committee (Chum Advisory Committee or Chum Working Group). The Chum Working Group represents interests for Strait of Georgia (mid-Vancouver Island Areas 14-19), Johnstone Strait, WCVI and Fraser River Chum salmon-directed fisheries. Fishing opportunities for Chum salmon are evaluated at weekly meetings of the Chum Working Group that usually start in the first week of October. In-season data is reviewed on a weekly basis until the conclusion of the fishing season that usually occurs around the end of November. The Chum Working Group includes internal (CDFO staff) and external (First Nations, commercial and recreational) representation and has been in operation since 2004. Additionally, Chum salmon management in Area 18 is also guided by advice from the Cowichan Fisheries Roundtable.

Chum salmon fishing opportunities in the Strait of Georgia PFMA's are predominately shaped by in-season escapement information, test fishing data, commercial harvesting data from Johnstone Strait fisheries when available, and coast-wide allocations of Chum salmon. When escapement goals are achieved (Table 3-2) or stock abundance allows, commercial gill net, purse seine and troll fisheries can be permitted. As mentioned, the exception is Area 14 where a pre-season forecast of returning Chum abundance is used in addition to the in-season information listed above, to guide management decisions on fishing opportunities (CDFO 2012).

Table 3-2. Current spawning escapement goal, hatchery requirements and overall escapement goal for Chum salmon returning to the Strait of Georgia by PFMA's and system.

PFMA	System	Spawning Escapement Goal	Hatchery Requirements	Overall Escapement Goal
Area 14	Puntledge River	60,000	10,000	300,000
	Big Qualicum River	100,000		
	Little Qualicum River	130,000		
Area 16	Jervis Inlet Streams	n/a	n/a	110,000
Area 17	Nanaimo River	n/a	n/a	60,000
Area 18	Cowichan River[1]	n/a	n/a	160,000
Area 19	Goldstream River	n/a	n/a	15,000

(1) Cowichan River Chum has an escapement target.
(n/a) not applicable.

Fishing opportunities in the Strait of Georgia are constrained by concerns over by-catch of passing Chum salmon stocks and local Chinook and Coho salmon populations. These concerns are addressed by Area specific pre- and in-season management measures that may include:

- *area closures*: beach boundaries and limiting fisheries to terminal areas to minimize impacts on passing stocks; and,
- *non-retention*: of Chinook and Coho salmon.

As well, to reduce by-catch mortality and to improve the quality of catch data, additional pre-and in-season management measures may be implemented in the Strait of Georgia fisheries. These additional measures may include:

- *daylight fishing only*: in the gill net fishery;
- *maximum soak time*: in the gill net fishery;
- *mandatory brailing*: in the seine fishery;
- *barbless hooks*: in the troll fishery; and,
- *on-board observers*: if high by-catch occurs.

Pre- and in-season management measures aimed at reducing by-catch mortality are commonly implemented after consultation with the Chum Working Group.

First Nations FSC fisheries remain a priority and occur in terminal areas targeting individual populations from river systems within or adjacent to band territories. Harvest limits may be set when there are conservation concerns for the target population; however, First Nations FSC fisheries have priority over other fisheries. Generally, catch and effort in First Nations FSC Chum salmon fisheries is low compared to commercial Chum salmon fisheries.

Although tidal recreational fisheries are open throughout the Strait of Georgia, Chum salmon are not commonly targeted by recreational anglers. Nevertheless, the Strait of Georgia recreational

Chum salmon catch is estimated annually through a Creel Survey conducted by CDFO. In most years, the Creel Survey operates from the beginning of May through to the end of September. Data from this survey is compiled and analyzed to produce catch and effort statistics by Area for each salmon species. Non-tidal recreational fisheries vary by Area and are considered if escapement and FSC needs have been met.

3.3.2.1 Area 14 Chum Salmon Management Strategy

Chum salmon returning to Area 14 have been enhanced since the late 1960's and terminal fisheries targeting the enhanced Chum salmon populations of Puntledge, (Big) Qualicum and Little Qualicum rivers have occurred in October and November since the early 1970's. Returning Area 14 Chum salmon abundance is forecasted pre-season using brood escapement, average survival and age composition. In-season run strength is assessed from any early catch information, visual observations at river estuaries and escapement counts to the three enhanced river systems.

The spawning escapement goals for Chum salmon to the three river systems are 60,000 to Puntledge River, 100,000 to (Big) Qualicum River and 130,000 to Little Qualicum River; including enhancement facility requirements of 10,000, the overall escapement goal is 300,000 Chum salmon for Area 14 (Table 3-2). Spawning escapements are monitored by CDFO Stock Assessment and hatchery staff.

The recommended approach regarding Chum salmon-directed fishing opportunities in Area 14 is made at the first meeting of the Chum Working Group. This meeting is tentatively scheduled for the first week of October; Chum Working Group meetings are subsequently held every week until late November.

Commercial Chum salmon-directed fisheries have a specific harvest strategy, implemented since 1981 that consists of limited early harvest prior to any escapement occurring. The allowable early Chum salmon harvest is set at 65% of the predicted surplus. The predicted surplus is calculated by subtracting the overall escapement goal (300,000; Table 3-2) and a buffer (100,000) from the pre-season terminal run size forecast (CDFO 2012). The buffer safeguards against errors in the pre-season forecast of Area 14 stock abundance.

The limited early commercial harvest of Chum salmon is planned pre-season and executed in-season in the second or third week of October based on whether a surplus, using the formula described above, is identified. However, if catches in the commercial Chum salmon fisheries in Johnstone Strait indicate low Chum salmon abundance, a decision on the approach in Area 14 may be deferred until the following week.

The management objectives for Area 14 are:

- achieve Area 14 Chum escapement requirements of 300,000;
- ensure adequate Chinook and Coho escapements to Area 14 enhancement facilities;
- provide access to First Nations for FSC purposes;
- minimize the harvest of passing salmon populations;
- maximize economic return;

- work towards south coast Chum salmon allocation targets for gill net, seine net and troll sectors;
- attempt to manage initial fisheries in Area 14 to avoid large surpluses (i.e. greater than 100,000).

Starting in the second or third week of October, opportunities for gill net, seine net and troll fisheries are based on pre-season forecasts, in-season catch per unit effort (CPUE) information from commercial Chum salmon fisheries in Johnstone Strait, and escapement information. Escapement information becomes increasingly important when considering further commercial opportunities in the latter part of October. These commercial opportunities are determined at the weekly Chum Working Group meetings and may include consideration for:

- *limited effort seine net fishery*: a limited effort seine fishery with a harvest target will be considered from late October to late November, based on Chum salmon escapement, abundance in the approach areas and South Coast allocation guidelines. Full fleet opportunities may also be available;
- *expanded gill net and troll fishery*: if gear counts indicate a modest fleet size of 50 vessels or less, gill net and troll openings may be expanded beyond one to two days per week; as well, additional fishing opportunities for gill net and troll may be considered following the seine net fisheries; and,
- *additional fishing days*: additional fishing days are considered if fishing time is lost due to poor weather conditions.

Once spawning escapement goals and hatchery requirements have been achieved, any returns above the overall escapement goal may be harvested (CDFO 2012).

Commercial fishing opportunities are constrained by concerns over local and passing Chinook, Coho and Chum salmon populations. Management measures to address these concerns can include:

- *area closures*: beach boundaries to protect Chinook and Coho salmon (boundaries may range from half a mile to one and a half miles depending upon by-catch concerns and time of year); French Creek radius boundary and Baynes Sound area closures to protect wild Chum and Coho salmon populations;
- *non-retention*: of Coho salmon;
- *maximum soak time*: in the gill net fishery;
- *mandatory brailing*: in the seine fishery;
- *barbless hooks*: in the troll fishery;
- *daylight fishing only*: in the gill net fishery if there are significant levels of by-catch; and,
- *outside boundaries*: designed to minimize impacts on passing salmon populations.

First Nations FSC fisheries are conducted in Area 14 and at the enhancement facilities prior to consideration of ESSR fisheries targeting Chum salmon. Tidal recreational fisheries are subject

to the normal daily and possession limits for Chum salmon (daily limit four per day/possession limit eight) and are open throughout the Area.

Once escapements have been confirmed, non-tidal recreational fisheries for Chum salmon in the Puntledge and Big Qualicum rivers will be considered. These fishing opportunities may occur as early as the second to fourth week of October and are based, in part, upon in-season and past return timing of Chum salmon.

3.3.2.2 Area 16 Chum Salmon Management Strategy

Area 16 Chum salmon-directed fisheries target wild Chum salmon populations returning to river systems in the Jervis Inlet area. The main systems are Tzoonie, Deserted and Skwawka Rivers.

The overall escapement goal for Jervis Inlet streams is 110,000 Chum salmon (Table 3-2). Terminal fisheries occur when achieving the individual or overall escapement goal has been assured. Assessment in the area is conducted by CDFO Charter Patrol vessels, CDFO Stock Assessment, and members of the Sechelt Indian Band.

Due to the inability of pre-season forecasts to reliably predict returns of Area 16 Chum salmon, pre-season fishing plans are not developed for Area 16 (CDFO 2012).

In-season management is guided by advice from the Chum Working Group. Commercial fishing opportunities are evaluated at the Chum Working Group's weekly meetings where in-season data is reviewed. Fishing opportunities are also affected by coast-wide allocations of Chum salmon.

The potential implementation of a limited fleet-size (e.g. three to five vessels) weekly assessment fishery in the lower Jervis Inlet area is being explored by the CDFO with domestic gill net and troll commercial harvest committees. A weekly assessment fishery in the last two weeks of October and the first week of November may, over time, provide an earlier indication of overall abundance returning to this Area (CDFO 2012).

Full fleet Chum salmon fishing opportunities will be provided in an area when the escapement goals have been achieved; achievement of the escapement goals includes combining estimates of Chum salmon in-river and the estimate of Chum salmon inside a designated sanctuary area (CDFO 2012). The earliest potential fishing opportunity is usually anticipated near the end of October.

Chum salmon fishing opportunities are constrained by concerns over fishing impacts on Coho salmon and passing Chum salmon populations. To address these concerns, there is mandatory non-retention of Coho salmon and fishing is limited to terminal areas.

Historically, Chum salmon fishing opportunities in Area 16 do not occur on a regular basis. There have been no fisheries in Area 16 in recent years.

3.3.2.3 Area 17 Chum Salmon Management Strategy

Chum salmon fisheries in Area 17 are directed primarily at Nanaimo River populations. On poor return years, the Nanaimo River Chum salmon stock is supplemented by production from the Nanaimo River Hatchery.

The overall escapement goal for the Nanaimo River is 60,000 Chum salmon (Table 3-2). Chum salmon escapement estimates are derived from a combination of helicopter surveys, joint DFO/Snuneymuxw in-river assessments, charter patrol ground surveys of approach and terminal areas and fishery officer patrols of the river.

Pre-season forecasts of Chum salmon abundance are helpful in defining possible opportunities, but decisions to open commercial fisheries are not based on pre-season information (CDFO 2012). Area 17 Chum salmon are managed as a component of the "mixed-stock harvest strategy" for Chum salmon and in-season management is guided by advice from the Chum Working Group as outlined for Areas 14 and 16. Fishing opportunities are planned in-season based on escapement information and shaped by coast-wide allocations of Chum salmon. Escapements can fluctuate annually and fishery opportunities are evaluated during the weekly in-season review of Nanaimo escapement estimates within the Chum Working Group process.

Opportunities for gill net, troll and seine net fisheries are discussed once Chum salmon have started to enter the Nanaimo River and are present in terminal areas. Final decisions are made at the weekly Chum Working Group meetings. If commercial opportunities are identified, management will be guided by the following considerations:

- gill nets open for one or two days; fishing days and opening duration subject to escapement levels;
- troll open seven days per week due to a demonstrated low catch rate;
- after initial opening, continued fishing opportunities depend upon information derived from CPUE in the commercial fisheries, and on-going approach area and in-river assessments;
- if harvest remains "good" and the escapement goal is reached, commercial fisheries can continue; and,
- additional fishing days will be considered if time is lost due to poor weather conditions.

Commercial fishing opportunities are constrained by concerns over domestic Chinook & Coho salmon populations and passing Chum salmon. Management measures to address these concerns can include:

- *area closures*: subarea boundaries protecting migrating Fraser River Chum salmon and confine the fishery to the Nanaimo River stock;
- *non-retention*: of Coho and Chinook salmon;
- *maximum soak time*: in the gill net fishery if Coho salmon encounters are high;
- *barbless hooks*: in the troll fishery; and,
- *daylight fishing only*: in the gill net fishery if there are significant levels of by-catch.

In-season management measures aimed at reducing by-catch mortality (e.g. maximum soak time and daylight fishing only in the gill net fishery) would be implemented after consultation with the Chum Working Group.

First Nations FSC fisheries as well as tidal/non-tidal recreational fisheries are conducted on these Area 17 populations. Local FSC opportunities are undertaken by Nanaimo First Nations in consultation with the Department. Tidal recreational fisheries are subject to the normal daily and possession limits and there are no closed areas. There are no opportunities for non-tidal recreational fisheries in the Nanaimo River.

3.3.2.4 Area 18 Chum Salmon Management Strategy

Area 18 Chum salmon-directed fisheries target primarily Cowichan River Chum populations although Goldstream River Chum salmon are also harvested to some extent. Commercial fishery openings in mid to late November are limited to Satellite Channel to minimize impact on the earlier timed Goldstream River populations. Chemainus River Chum salmon populations are also impacted but likely to a lesser extent (CDFO 2012).

A revised overall escapement target of 160,000 has been set for Cowichan River Chum salmon (Table 3-2). The updated Chum salmon target is based on habitat area and Chum salmon spawning densities in the Cowichan River (CDFO 2012). In-river Chum salmon escapement estimates are provided by the operation of a DIDSON Counter (Dual-frequency Identification Sonar) located in the lower river.

Pre-season forecasts of abundance are helpful in defining possible commercial opportunities, but decisions to open commercial fisheries are not based on pre-season information (CDFO 2012). In-season management is guided by advice from the Cowichan Fisheries Roundtable (the Roundtable) and the Chum Working Group. Commercial fishing opportunities are evaluated during the weekly in-season meetings of the Roundtable and the Chum Working Group and are shaped by coast-wide allocations of Chum salmon.

The Cowichan Harvest Roundtable's goals are to identify potential commercial fishing opportunities earlier in the run timing, to harvest any identified surplus throughout the run-curve (instead of cropping the surplus from the end of the run), and to be able to make decisions quickly so that fisheries can be initiated in a timely manner (CDFO 2012).

Commercial fishery openings are planned in-season based on in-season escapement estimates, and the assessment of marine abundance through an Area 18 test fishery and/or over-flights, and are shaped by the coast-wide allocations of Chum salmon (CDFO 2012). The following guidelines are used in-season to manage the commercial fisheries directed at Area 18 Chum salmon:

- 25,000 Chum salmon enumerated in the Cowichan River triggers the start of the Area 18 seine net test fishery;
- over-flight and Area 18 seine net test fishery information will be used in conjunction with upper river spot indicators to determine whether the remainder of the escapement goal is expected to be achieved;
- small gill net and troll fisheries may be initiated on short notice if in-stream migration numbers and marine approach area abundance warrants an opening;
- troll fisheries may open seven days per week due to demonstrated low catch rates;

- sustained in-river Chum salmon migration and Chum salmon abundance in the marine area that indicates a higher probability of reaching escapement goals, may trigger a seine net fishery;
- subject to fishery review and continued escapements, commercial fisheries may continue and opening types will be adjusted to meet overall guidelines; and,
- specific fishing dates and boundaries will be determined in-season through the Roundtable and Chum Working Group process; timing of migration is important in terms of the health of the run and in relation to interception of Goldstream River Chum salmon in the Area 18 fisheries.

Like other Strait of Georgia PFMAs, commercial fishing opportunities in Area 18 are constrained by concerns over domestic Chinook & Coho salmon populations and passing Chum salmon. Management measures to address these concerns can include:

- *area closures*: subarea boundaries to protect Coho salmon holding off Cherry Point; limiting commercial fisheries to Satellite Channel to minimize impact on the earlier timed Goldstream River Chum salmon populations; beach boundaries to protect Chinook and Coho salmon;
- *non-retention*: of Coho salmon;
- *maximum soak time*: in the gill net fishery if Coho salmon encounters are high;
- *mandatory brailing*: in the seine net fishery;
- *barbless hooks*: in the troll fishery; and,
- *daylight fishing only*: in the gill net fishery if there are significant levels of by-catch.

In-season management measures aimed at reducing by-catch mortality (e.g. maximum soak time and daylight fishing only in the gill net fishery) would be implemented after consultation with the Roundtable and the Chum Working Group.

First Nations FSC fisheries and tidal/non-tidal recreational fisheries are conducted on these Area 18 Chum salmon populations. Tidal recreational fisheries are subject to the normal daily and possession limits. Non-tidal recreational fisheries will also be considered if escapement targets and First Nations FSC needs are achieved.

3.3.2.5 Area 19 Chum Salmon Management Strategy

Chum salmon fisheries are directed primarily at Goldstream River populations although some Cowichan River Chum salmon are also harvested. The overall escapement goal for Goldstream River is 15,000 Chum salmon (Table 3-2). Goldstream River is a relatively small system with good viewing conditions; as such, escapement estimates are derived from stream walks.

Due to the inability of pre-season forecasts to reliably predict returns of Area 19 Chum salmon, pre-season fishing plans are not developed for Area 19. In-season management is guided by advice from the Chum Working Group. Commercial fishing opportunities are evaluated at the Chum Working Group's weekly meetings where in-season data is reviewed. In-season escapement information forms the basis for determining commercial fishing opportunities. Area

19 falls under the same management regime as other Strait of Georgia PFMA's; consequently, fishing opportunities are also shaped by coast-wide allocations of Chum salmon.

If commercial opportunities are identified, the following guidelines are used in-season to manage the commercial fisheries directed at Area 19 Chum salmon:

- seine and gill nets will alternate fishing days subject to escapement estimates and the entire Chum Working Group review process and status in the coast wide gear type allocation;
- after the initial opening, continued commercial fishing opportunities will depend upon information derived from CPUE in the commercial fisheries, and on-going approach area and in-river assessments, as well as encounters of Chinook and Coho salmon;
- if harvest remains good in the commercial fishery and the overall escapement goal is reached, commercial fisheries may continue; and,
- any economic opportunity (EO) fishery for Saanich Tribes will be conducted separately from FSC fisheries under the same priority and similar rules as the commercial fishery; salmon harvested in any EO fishery will be off-set with licenses retired from the commercial sector.

Commercial fishing opportunities in Area 19 are constrained by concerns over domestic Chinook & Coho salmon populations and passing Chum salmon. Management measures to address these concerns can include:

- *area closures*: subarea boundaries to protect Goldstream River Chinook and Coho salmon holding at Squally Reach and minimize encounters of Cowichan River Chum salmon; commercial fishery openings set for mid to late November are limited to portions of Saanich Inlet that are outside or to the north of Squally Reach;
- *non-retention*: of Coho and Chinook salmon;
- *maximum soak time*: in the gill net fishery if Coho salmon encounters are high;
- *mandatory brailing*: in the seine net fishery;
- *barbless hooks*: in the troll fishery;
- *daylight fishing only*: in the gill net fishery if Coho salmon encounters are high;
- *selective fishing techniques*: commercial fisheries will utilize selective fishing techniques to minimize by-catch impacts; and,
- *on-board observers*: on-board observers could be employed if high by-catch occurs.

3.3.3 Fraser River Chum Salmon Management Strategy

The management strategy for Fraser River Chum salmon includes management goals and harvest allocation objectives for Chum salmon fisheries occurring within the Fraser River. Fisheries are structured to ensure a spawning escapement of 800,000 Chum salmon using in-season information derived from the CDFO Albion Chum salmon test fishery (see section 3.3.3.1).

Decision rules that guide the management of Fraser River Chum salmon fisheries are summarized in Table 3-3.

Additionally, management of in-river Chum salmon fisheries is guided by the need to minimize impacts on co-migrating stocks of concern, including Interior Fraser Coho salmon and Interior Fraser Steelhead. In order to limit incidental impacts on Interior Fraser Coho salmon, fishing for all sectors (First Nations, recreational, and commercial) is restricted from early September to mid-October within the Fraser River mainstem below Sawmill Creek. Conservation measures taken to protect Interior Fraser Steelhead are developed in conjunction with the B.C. Ministry of Environment on an annual basis, and are primarily focused on reducing the impact of Fraser River commercial gill net fisheries. In recent years, these restrictions have resulted in the delay of commercial fishing opportunities for Chum salmon until late October, with the exception of those fisheries that operate with selective gear.

Table 3-3. Key decision points for Fraser River Chum salmon management.

Run Size	Harvest Plan	First Nations	Commercial	Recreational
< 800,000 in Fraser	< 10%	Limited (Reduced hours and days/week fishing).	Closed	Mainstem Fraser River closed, restricted openings on tributaries
800,000-916,000 in Fraser	Catch not to exceed 81,000 (72,000 First Nations and 9,000 test fishing)	Normal (72,000)	Closed	Mainstem Fraser River open, restricted openings on tributaries
916,000-1,050,000 in Fraser	Commercial catch not to exceed 10% for Chum.	Normal (72,000)	Opened (35,000-105,000)	Opened
> 1,050,000 in Fraser	Commercial catch not to exceed 15% for Chum.	Normal (72,000)	Opened	Opened

3.3.3.1 Fraser River In-season Terminal Abundance Estimation

Terminal abundance of Fraser River Chum salmon is estimated using a Bayesian model that incorporates pre-season information on run size and migration timing, with in-season information on Chum salmon catch from the Albion Chum salmon test fishery (Gazey and Palermo 2000).

The Albion Chum salmon test fishery has operated annually since 1979 on the lower Fraser River in Area 29 at Albion (near Fort Langley). The test fishery is conducted with a drifted gill net at a specific site near the old Albion ferry crossing. The test fishery begins in early September of each year, and usually fishes until the end of November. On each day of operation, the boat fishes two sets, timed to coincide with the daily high tide. The Albion Chum salmon test fishery normally fishes every other day from September 1st through October 20th, alternating days with the Albion Chinook salmon test fishery (which fishes an 8" mesh gill net

during this period). From October 21st through the end of November, the Chum salmon test fishery operates daily. The gill net used in the Albion Chum salmon test fishery is 150 fathoms long, constructed from uniform 6.75" mesh.

The first in-season estimate of terminal Fraser River Chum salmon abundance is typically provided in mid-October. Limited First Nations FSC fisheries for Fraser Chum salmon may be permitted prior to this date, unless a conservation concern has been identified.

3.3.4 West Coast Vancouver Island Chum Salmon Management Strategy

Chum salmon stocks return to all areas on the West Coast of Vancouver Island (WCVI). When stock abundance allows, commercial Chum salmon fisheries are conducted in the marine waters outside Nitinat Lake (Area 21), Barkley Sound (Area 23), Clayoquot Sound (Area 24) and Outer Nootka Sound/Tlupana and Esperanza Inlet (Areas 25). Both commercial gill net and purse seine fleets target WCVI Chum salmon in these Areas.

A pre-season forecast of the return of WCVI Chum salmon is predicted for population aggregates corresponding to CDFO's Pacific Fishery Management Areas. Natural and enhanced returns are approximated through separate models and summed to produce a total return forecast for each Area. However, the relative inaccuracy of the pre-season forecasts resulted in the adoption of a fixed harvest rate strategy in the early 2000's for those fisheries targeting mixed stock aggregates.

With the exception of near-terminal areas, such as Nitinat (Area 21 & 22) or Tlupana Inlet (Area 25) where hatchery stocks dominate, WCVI Chum salmon fisheries are currently managed to an exploitation rate of approximately 20% or less. Exploitation is controlled by limiting fishing effort to specific areas, specific times or to a specific number of vessel fishing days per week. Purse seine opportunities generally occur when excess salmon to spawning requirements (ESSR) are identified in near terminal areas (e.g. hatchery stocks returning to Nitinat River or Tlupana Inlet).

Since the late 1990's, most of the commercial harvest has occurred offshore of Nitinat Lake (Area 21) or in Nootka Sound/Tlupana Inlet (Area 25). However, starting in 2004, the commercial gill net sector conducted limited small fleet fishing opportunities for Chum salmon in terminal areas other than Nitinat and Nootka/Tlupana. The intent was to determine if small scale gill net fisheries could be economically viable while limiting exploitation rates to 10 to 20% of returning stocks. Additionally, it was expected these limited fleet fisheries could provide useful stock assessment information. Areas of interested included: Barkley Sound (Area 23), Clayoquot Sound (Area 24), and Esperanza Inlet (Area 25).

WCVI First Nations FSC fisheries remain a priority and occur in terminal areas targeting individual populations from river systems within or adjacent to band territories. Harvest limits may be set when there are conservation concerns for the target population; however, First Nations FSC fisheries have priority over other fisheries. Generally, harvest and effort in First Nations FSC Chum salmon fisheries is low compared to commercial Chum salmon fisheries.

Chum salmon are not commonly targeted by recreational anglers on the WCVI . Nevertheless, the WCVI recreational Chum salmon catch is estimated annually through a Creel Survey

conducted by CDFO. Creel Survey information is augmented by logbook and manifest records of catch and effort submitted by lodges operating guided fishing trips on the WCVI. These data are compiled and analyzed to produce catch and effort statistics by Area for each salmon species.

3.3.4.1 Nitinat Chum Salmon Management Strategy

Of importance to the Pacific Salmon Treaty is the WCVI group of Chum salmon populations returning to the Nitinat watershed (Nitinat River and Nitinat Lake & tributaries). This Nitinat stock is the most significant WCVI group of populations and includes production from a major CDFO hatchery on the Nitinat River.

The Nitinat commercial Chum salmon fishery (Area 21), along with the test fishery and ESSR fisheries (Area 22), is the largest fishery on the WCVI and targets returning Nitinat River hatchery Chum salmon. In the past, catch of non-WCVI Chum salmon has occurred in the outside seaward portion of the Nitinat fishing area. Management actions have been implemented to reduce this catch of non-WCVI Chum salmon by restricting the Nitinat fishery to subareas closer to the terminal area (i.e. outlet of Nitinat Lake). More recently, First Nations' ESSR harvests have occurred within Nitinat Lake (Area 22). Historical Chum salmon harvest is shown in Table 3-10.

The spawning escapement target for Chum salmon returning to the Nitinat system (i.e. Nitinat River and other tributaries to Nitinat Lake) has been set at 175,000 fish (CDFO 2012). The target distribution of this spawning escapement between Nitinat River and the tributaries to Nitinat Lake has varied slightly over the last number of years; currently it is set at 125,000 into the Nitinat River and 50,000 into other Nitinat Lake tributaries. This spawning escapement requirement is set at a level to ensure that all run timing components are represented. Additional allocation for First Nations FSC requirements and hatchery requirements (i.e. broodstock) may total up to 50,000 Chum salmon. Consequently, the *gross escapement requirement* (spawning escapement + FN FSC requirements + hatchery requirements) for this Nitinat group of populations is 225,000 Chum salmon (CDFO 2012). Historical Chum salmon escapements are shown in Table 3-10.

A pre-season forecast of current year returns for the Nitinat stock is approximated based on broodyear escapements, estimated freshwater production from natural spawners, hatchery production, average age at return, environmental and ocean condition factors during brood ocean entry and estimated marine survival of each brood year class.

A pre-season fishing plan is commonly developed by the end of the summer and is based on the forecast of current year returns. Opportunities for gill net and limited effort purse seine fishing in the early portion of the fishery (early to mid-October) may be provided with an allocation target of 75% gill net and 25% purse seine; the overall fishery allocation target is 30% gill net and 70% seine. If the forecast surplus is low, a gill net test fish program outside Nitinat Lake may be implemented to provide additional abundance information. Depending on in-season test fishing results, achieving escapement milestones into Nitinat Lake, and on the harvest allocation between the two net fisheries, these early opportunities may be followed later in the season by the traditional full fleet purse seine and gill net fisheries (CDFO 2012).

In addition to concerns over catch of non-WCVI Chum salmon, early season opportunities are constrained by concerns over by-catch of Interior Fraser River Steelhead (Thompson River) and passing stocks of Coho salmon. Since 1995, these by-catch concerns in the commercial Nitinat fishery have been addressed by:

- *delayed opening dates*: the first commercial gill net fishery, if conducted, has been delayed until the beginning of October since 1998;
- *reduced fishing areas*: the traditional fishing area has been reduced to within a one-mile boundary between lines true south from Pachena and Dare Points (a portion of Area 21);
- *increased use of weed lines*: a 1.2m - 2.0m weed line for gill nets; and,
- *species selective fishing techniques*: non-retention of Coho salmon and Steelhead.

Additionally, to reduce by-catch mortality and to improve the quality of catch data, the following measures have been implemented in the Nitinat fisheries:

- *daylight fishing only*: gill net fishery;
- *mandatory functional revival tanks*: in purse seine and gill net fisheries;
- *on-board observers*: portions of purse seine and gill net fleet; and,
- *logbooks and weekly hail-ins*: purse seine and gill net fisheries.

The in-season management of the Nitinat fisheries (Area 21 & 22) are based on achieving the *gross escapement requirement* into the Nitinat watershed. A gill net test fishing vessel (operating in Nitinat Lake), broodstock collection success, hatchery swim-ins, and visual surveys of Nitinat River spawners are used to determine whether the weekly *escapement milestone levels* into Nitinat Lake are achieved (CDFO 2011). Weekly fisheries are generally scheduled in Area 21 and surrounding waters to harvest any identified surplus.

First Nations FSC fisheries remain a priority and occur in terminal areas of Nitinat (Areas 21 & 22). First Nations ESSR fisheries can also occur in Nitinat Lake (Area 22) targeting returns surplus to spawning and hatchery requirements.

3.4 Annual Fishery Descriptions

Fisheries targeting Chum salmon in Johnstone Strait, the Strait of Georgia, the Fraser River and on the West Coast of Vancouver Island (WCVI) generally begin in late September and end in November. These fisheries are directed at fall Chum salmon.

In addition to these directed fisheries, a bycatch of Chum salmon may occur in fisheries directed at Sockeye and Pink salmon earlier in the season. This Chum salmon bycatch is assumed to be comprised mainly of summer Chum salmon. The summer Chum salmon harvest in boundary area fisheries are presented in Table 3-4.

The main components of the Inside South Coast (ISC) Chum salmon return a5re made up of both Fraser and non-Fraser stocks. These stocks are typically dominated by 4 year old fish that out-migrated to the ocean in 2009. It was quite apparent that other salmon species that also out-migrated in 2008 encountered favorable marine conditions and improved survivals (Pink salmon

and Coho salmon returns in 2009, and Fraser Sockeye salmon returns in 2010). The pre-season expectation for ISC Chum suggested the return would be average to below average.

Table 3-4. Estimated harvest of summer Chum salmon by PFMA for commercial, research and test fishing vessels 1 (July through the second week of September), 2003–2012.

Year	Statistical Weeks	Pacific Fishery Management Area					
		18	19	20	21	29[2]	Total
2003	7/1–9/2	0	0	27	0	54	81
2004	7/1–9/2	0	0	17	0	686	703
2005	7/1–9/2	0	0	0	0	115	115
2006	7/1–9/2	0	0	52	0	419	471
2007	7/1–9/2	0	0	0	0	49	49
2008	7/1–9/2	0	0	0	0	67	67
2009	7/1–9/2	0	0	0	0	27	27
2010	7/1–9/2	0	0	16	0	384	400
2011	7/1–9/2	0	0	0	0	883	883
2012	7/1–9/2					125	125
Average		0	0	15	0	266	281

(1) Does not include PSC test fisheries harvest.
(2) Majority of this harvest is fresh water based and likely of Fraser River origin.

The following sections describe the fisheries directed at fall Chum salmon in each of the Southern B.C. areas in 2012.

3.4.1 Johnstone Strait

The Johnstone Strait test fishery provided timing and index of abundance information of the 2011 return which is important for assessing the performance of the 20% fixed harvest strategy implemented in the Johnstone Strait fisheries. It also provided an index of abundance that was used to determine the likelihood of whether the abundance of returning Chum salmon is over the 1.0 million critical abundance level required to continue with commercial openings. Relatively strong catch per unit effort in the test fishery was confirmed by a large catch in the 1st planned purse seine opening in the beginning of October. The indices of abundances were reviewed and it was determined that the returning abundance was likely higher than the critical threshold required for continuation of commercial fisheries. All subsequent commercial openings in Johnstone Strait were prosecuted as planned. Age composition derived from the test-fishery and commercial samples demonstrated a higher than average contribution of the 5-year old brood component. Escapements and catches in 2012 suggested returns were average to above average in many Non-Fraser populations. Table 3-5 outlines the duration and Chum salmon harvest, of fishery openings during the 2012.

In 2012, there were two competitive commercial purse seine openings; three gillnet openings in and one troll individual transferable quota (ITQ) fishery in Johnstone Straits (Area 12 and Area 13). The total 2012 commercial harvest for Johnstone Strait, including test fishery harvest, was

392,608 Chum salmon (Table 3-5). There were no directed commercial Chum salmon fisheries in the terminal areas of Johnstone Strait. Recreational harvest was low in Johnstone Strait (estimated at 431 Chum salmon; Table 3-5) with little monitoring during the month of October. First Nations FSC harvest was estimated at 13,106 in the Johnstone Strait area (Table 3-5). The total estimated harvest of Chum salmon in Johnstone Strait in 2012 was 406,145.

Table 3-5. Estimated Chum salmon harvest from Chum salmon-directed fisheries occurring in Johnstone Strait by PFMA, 2012.

Gear Type	Area	Fishery Dates		Fishery Duration (hours)	Estimated Harvest
		Start	End		
Purse Seine (Test)	12	Sep. 17	Oct. 29	n/a	1,278
Purse Seine	12	Oct. 3	Oct. 3	12	99,975
	13	Oct. 3	Oct. 3	12	103,440
	12	Oct. 22	Oct. 23	15	3,968
	13	Oct. 22	Oct. 23	15	81,113
Gill Net	12	Oct. 5	Oct. 7	41	14,922
	13	Oct. 5	Oct. 7	41	7,675
	12	Oct. 11	Oct. 13	41	18,644
	13	Oct. 11	Oct. 13	41	21,875
	12	Oct. 24	Oct. 26	41	3,320
	13	Oct. 24	Oct. 26	41	8,851
Troll [1]	12	Sep. 28	Oct. 13	n/a [1]	66
	13	Sep. 28	Oct. 13	n/a [1]	12,574
	12	Oct. 14	Oct. 31	n/a [1]	0
	13	Oct. 14	Oct. 31	n/a [1]	14,907
Recreational [2]	12	n/a	n/a	n/a	0
	13	n/a	n/a	n/a	431
First Nations [2]	12	n/a	n/a	n/a	3,379
	13	n/a	n/a	n/a	9,727
Total					406,145

(1) The troll fishery was opened from Sep. 28 to Oct. 31. The fishery was an effort based quota over that time period.
(2) The recreational and First Nation fisheries time periods varied over the season.

3.4.2 Strait of Georgia

In 2012, the total return of Chum to Area 14 systems was within the preseason forecasted range (207,400 and 311,00). Commercial openings targeted Chum salmon returning to the three major systems in this area (Puntledge, Little Qualicum and Big Qualicum rivers). There were 2 competitive gillnet openings, 1 troll and 1 purse seine opening in Area 14. Total commercial catch associated with Area 14 fisheries was 14,070 Chum salmon (Table 3-6).

In-season assessments in Area 18 identified sufficient escapement levels in the Cowichan River to initiate fisheries. There were 2 competitive seine openings, 3 gillnet opening and a small test fishery harvesting a total of 152,174 Chum Salmon (Table 3-6).

The recreational creel survey within the Strait of Georgia area was not conducted after September in 2012.

The harvest by First Nations in the Strait of Georgia in 2012 was estimated to be 5,771 Chum salmon (Table 3-6).

The total estimated harvest of Chum salmon in the Strait of Georgia in 2012 was 172,015.

Table 3-6. Estimated Chum salmon harvest from Chum salmon-directed fisheries occurring in the Strait of Georgia by PFMA, 2012.

Gear Type	Area	Fishery Dates		Fishery Duration (hours)	Estimated Harvest
		Start	End		
Purse Seine (Test)	18-19	Oct. 25	Nov. 27	n/a	605
Purse Seine	14	Nov. 21	Nov. 23	58	0
	18	Nov. 7	Nov. 10	44	86,235
	18	Nov. 11	Nov. 15	55	4,868
Gillnet	14	Oct. 28	Oct. 30	48	14,058
	14	Nov. 20	Nov. 23	72	12
	18	Nov. 3	Nov. 3	10	14,817
	18	Nov. 4	Nov. 10	43	45,018
	18	Nov. 11	Nov. 13	33	631
Troll	14	Oct. 28	Oct. 30	48	0
Recreational [1]	14-19, 28, 29 [3]	May 1	Sep. 30	n/a	13
First Nations [2]	14	n/a	n/a	n/a	0
	15	n/a	n/a	n/a	221
	16	n/a	n/a	n/a	0
	17	n/a	n/a	n/a	280
	18	n/a	n/a	n/a	5270
	19	n/a	n/a	n/a	0
	28	n/a	n/a	n/a	0
Total					172,028

(1) The recreational fishery was not monitored after September; harvest of Chum salmon was likely very low.
(2) The First Nation fisheries time periods varied over the season.
(3) Marine subareas of Area 29; i.e. does not include an estimate for Chum salmon harvest in the tidal portion of the lower Fraser River downstream of Mission BC (Appendix B3).
(n/a) not applicable.

3.4.3 Fraser River

Directed Chum salmon fisheries occur within the Fraser River for all fishing sectors, including First Nations, recreational, commercial, and test fisheries. In recent years, significant conservation measures have been implemented in-river during the Fraser River Chum salmon migration period in order to protect co-migrating stocks of concern, particularly Interior Fraser Coho salmon and Interior Fraser Steelhead. Depending on the fishery, these measures have included time and area closures, gear restrictions and release requirements.

The escapement objective for Fraser River Chum salmon is 800,000 spawners. As described in section 3.3.3 (*Fraser River Chum Salmon Management Strategy*), Chum salmon fishing opportunities are provided based on in-season assessments of run-size, using CPUE information from the CDFO Albion Chum salmon test fishery. The initial in-season estimate of terminal abundance, provided on October 16, 2012 was 1.941 million Chum salmon. Subsequent in-season estimates provided on October 22 and October 24 were 2.326 and 2.253 million Chum salmon, respectively.

Table 3-7. Estimated harvest of Chum salmon from salmon fisheries occurring in Area 29 (both marine and in-river) and in Region 2 (non-tidal) of the Fraser River, 2012.

Fishing Sector	Fishery Description	Target Species	Fishery Dates		Fishery Duration	Assessment Period [1]		Estimated Harvest
			Start	End		Start	End	
Test	Albion Chinook	Chinook	Apr 25	Oct 20	154 days	n/a	n/a	4,388
	Albion Chum	Chum	Sep 1	Nov 30	65 days	n/a	n/a	8,799
	Whonnock Sockeye	Sockeye	Jun 20	Sep 27	94 days	n/a	n/a	280
	Cottonwood Sockeye	Sockeye	Jul 16	Sep 14	61 days	n/a	n/a	20
	Test Subtotal							**13,487**
Commercial [2]	Area E Gill Net	Chum	Oct 25	Oct 25	1 day	n/a	n/a	60,300
	Area B Seine	Chum	Oct 27	Oct 28	2 days	n/a	n/a	104
	Commercial Subtotal							**60,404**
Recreational [3, 4, 5]	Fraser River Mainstem	Mixed	Jul. 16	Dec.31	169 days	Jul. 16	Nov. 30	2,298
	Chilliwack River	Coho	Jan. 1	Mar.31	91 days	Sep. 1	Nov. 15	4,633
		Mixed	Jul. 1	Dec.31	184 days			
	Nicomen Slough	Mixed	Jan. 1	Dec.31	366 days	Oct. 5	Nov. 30	9
	Recreational Subtotal							**6.940**
First Nations [2, 6]	FSC	Chinook	Jun 9	Sep 2	86 days	n/a	n/a	33
		Sockeye	July 20	Aug 26	38 days	n/a	n/a	5
		Chum	Oct 6	Nov 25	51 days	n/a	n/a	30,708
	ESSR	Chum	n/a	n/a	n/a	n/a	n/a	34,593
	EO	Chum	Oct 18	Nov 6	20 days	n/a	n/a	102,185
	First Nations Subtotal							**167,524**

(1) Assessment Period Start and End dates refer to the period of assessment for the recreational fisheries only.
(2) Fishery Start and End Dates for the commercial and First Nations fisheries reflect the first and last date the fisheries were permitted; the fisheries were not continuous between these dates.
(3) Fishery Start and End Dates for the recreational fisheries reflect the period the fishery was opened to the retention of Chum salmon; retention of other salmon species may have been allowed beyond these dates.
(4) The recreational estimates are for the periods of assessment; assessment periods may or may not coincide with Chum retention fishery opening and closing dates.
(5) Recreational estimates are preliminary.
(6) The Fishery Duration represents the maximum number of days provided to First Nations; individual First Nations may have fished for shorter periods.
(n/a) not applicable

First Nations FSC gill net fisheries targeting Chum salmon were initiated October 6 following a closure period to protect co-migrating Interior Fraser Coho salmon. These fisheries harvested a total of 30,708 Chum salmon. First Nations Economic Opportunity (EO) fisheries directed at Chum salmon in 2012 harvested 102,185 Chum (Table 3-7). In addition to these fisheries, certain First Nations groups were also provided access to Chum salmon that returned to hatchery facilities but were not required for broodstock. A total of 34,593 Chum salmon deemed to be surplus to spawning requirements (ESSR) were provided to First Nations from various hatchery facilities in 2012.

First Nations FSC Chinook and Sockeye-directed fisheries occurring in 2012 had minimal bycatch of Fraser Chum salmon, harvesting only 33 and 5 Chum salmon, respectively (Table 3-7). There were no sockeye-directed Economic Opportunity fisheries in 2012.

The total harvest of Chum salmon in all Fraser River First Nations fisheries (including hatchery ESSR fish) was 167,524 in 2012 (Table 3-7 and Table 3-8).

Table 3-8. Estimated harvest of Chum salmon from First Nations and commercial salmon fisheries occurring in Area 29 and Fraser River, 2003-2012.

Year	First Nations			Commercial			Total
	FSC	EO	ESSR	Area E GN Area B SN Area H TR	Albion and PSC Test Fisheries	Other Scientific Licenses [1]	
2003	26,970	28,790	41,527	45,365	10,735	n/a	156,618
2004	19,846	50,668	96,682	70,855	16,383	n/a	258,880
2005	7,267	95,527	38,487	56,898	12,920	n/a	212,770
2006	15,150	114,708	93,516	163,757	16,942	n/a	410,350
2007	13,344	77,490	29,884	30,400	7,650	n/a	163,332
2008	31,553	50,004	41,683	38,006	10,155	n/a	176,098
2009	12,991	68,150	8,458	42,116	9,249	n/a	144,163
2010	13,480	186	14,021	209	10,762	n/a	44,925
2011	22,331	4,886	50,867	36,058	3,553	n/a	117,695
2012	30,746	102,185	34,593	60,404	13,487	n/a	241,415
Average	**19,368**	**59,259**	**44,972**	**54,407**	**11,184**	**n/a**	**192,625**

(1) Includes "experimental" selective fishing scientific licenses issued under the CDFO Selective Fishing Program.
(n/a) not applicable.

The major Fraser River watershed recreational salmon fisheries impacting Chum salmon in 2012 include significant fisheries occurring in the lower Fraser River mainstem, the Chilliwack River and the Stave River, and minor salmon fisheries occurring on the Harrison River and the Nicomen Slough/Norrish Creek system. The latter four systems are tributaries to the Fraser River in the lower Fraser Valley. The recreational fisheries occurring in the Harrison and Stave rivers were not assessed in 2012.

The lower Fraser River mainstem was open to recreational angling and the retention of Chum salmon on July 16, 2012 (daily retention limit of 2). In 2012, this mainstem recreational fishery was assessed from July 16 to November 30; estimates of 2,298 and 6,798 Chum salmon were harvested and released, respectively (Table 3-7).

The Chilliwack River recreational fishery was open to the retention of Chum salmon from July 1 to December 31, 2012 (daily retention limit of 1). This fishery was assessed from September 1 to November 15; estimates of 4,633 and 32,826 Chum salmon were harvested and released, respectively (Table 3-7).

The Harrison River, Stave River and Nicomen Slough/Norrish Creek system recreational fisheries were open to the retention of Chum salmon year round (daily retention limit of 2). The Nicomen Slough/Norrish Creek fishery was assessed from October 5 to November 30, 2012.

Estimates of 9 and 1,520 Chum salmon were harvested and released, respectively for this fishery (Table 3-7). The recreational fisheries in the Harrison and Stave rivers were not assessed in 2012.

In total, for assessed recreational fisheries occurring in the lower Fraser River watershed in 2012, estimates of 6,940 and 41,145 Chum salmon were harvested and released, respectively (Table 3-7 and Table 3-9).

Commercial fisheries in the lower Fraser River (i.e. Area E gill net) are closed annually from early September to mid-October during the Interior Fraser Coho migration period. In recent years, this closure has been extended into late October to provide additional protection to Interior Fraser Steelhead. As a result, commercial Area E gill net Chum salmon fisheries now typically occur during the last week of October and first week of November. In 2012, there were early indications of abundance of Fraser chum, and the commercial fisheries proceeded immediately following the Fraser Steelhead closure period. There was one Area E commercial opening in the Fraser River on October 25, 2012 that harvested a total of 60,300 Chum salmon. The Area B seine fleet also mounted a limited-participation Chum-directed fishery off the mouth of the Fraser River on October 27 and 28, 2012. This fishery harvested 104 Chum salmon (Table 3-7).

Table 3-9. Estimated harvest of Chum salmon in assessed (i.e. surveyed) lower Fraser River recreational fisheries, 2003–2012.

Year	Recreational Fishery					
	Fraser River[1]	Chilliwack River	Nicomen Slough	Stave River	Harrison River	Total
2003	728	2,503	ns	ns	ns	3,231
2004	0	4,384	62	ns	ns	4,446
2005	39	1,624	8	ns	ns	1,671
2006	900	5,375	2	ns	ns	6,277
2007	3,007	1,553	4	ns	ns	4,564
2008 *	760	3,937	0	ns	ns	4,697
2009 *	43	2,404	10	ns	742	3,199
2010 *	1,549	1,142	10	3,578	ns	6,279
2011 *	32	278	14	ns	ns	324
2012 *	2,298	4,633	9	ns	ns	6,940
Average	936	2,783	13	3,578	742	4,163

(1) Mainstem portion of the lower Fraser River (downstream of Hope, B.C.; Appendix B).
(*) Preliminary estimates.
(ns) not surveyed.

In 2012, a total of 60,404 Chum salmon were harvested in commercial (excluding Economic Opportunity and test fisheries) fisheries in the Fraser River and the marine areas immediately off the Fraser River mouth (Table 3-7 and Table 3-8).

Four test fisheries operated in the Fraser River in 2012: the CDFO-operated Albion Chinook and Chum salmon gill net test fisheries and the PSC-operated Whonnock and Cottonwood Sockeye salmon gill net test fisheries. While Whonnock and Cottonwood test fisheries target Sockeye

salmon, the Albion test fishery assesses abundance of both Chinook and Chum salmon, using different net configurations to target the two different species (section 3.3.3.1).

In 2012, the Albion Chinook salmon test fishery operated from April 25 through October 20, and the Albion Chum salmon test fishery operated from September 1 through November 30. From September 1 to October 20, the Chinook and Chum test fisheries operated on alternating days (section 3.3.3.1). The Albion test fishery did not operate on October 25 due to gear conflicts with the Area E opening in the Fraser River. Chum salmon harvest in the Albion Chinook salmon test fishery, representing 154 fishing days, totaled 4,388 and harvest in the Albion Chum salmon test fishery, representing 65 days, totaled 8,799 Chum salmon (Table 3-7).

The PSC Whonnock Sockeye salmon test fishery operated daily from June 20 through September 14, 2012, then approximately every second day to September 27, 2012. Chum salmon harvest in this test fishery, representing 94 fishing days and 188 sets (two sets per day), totaled 280. The PSC Cottonwood Sockeye salmon test fishery fished daily from July 16 through September 14, 2012. Harvest in this test fishery, representing 61 fishing days and 61 sets (one set per day), totaled 20 Chum salmon (Table 3-7).

In total, an estimated 13,487 Chum salmon were harvested in the CDFO and PSC test fisheries occurring in the Fraser River in 2012 (Table 3-7 and Table 3-8).

3.4.4 West Coast Vancouver Island

There were seine and gill-net commercial fisheries in 2012 based on abundance in Nitinat Lake and River. Limited effort gill net fisheries did occur in Areas 23 and 24; harvest totaled 3,532 and 1,147 Chum salmon, respectively.

First Nations FSC harvest of Chum salmon occurred in all WCVI areas and totalled 6,068 for 2012.

3.4.4.1 Nitinat

The pre-season forecast for the 2012 return to the Nitinat watershed was 292,000 Chum salmon (relative to a gross escapement target of 250,000 Chum salmon for the Nitinat system). In-season assessment information provided by the in-lake gill net test fishery, in-lake purse seining for broodstock, and escapement surveys indicated the return was above expected weekly *escapement milestone levels* required to initiate commercial fisheries. As a result, commercial gill net and purse seine fisheries in Area 21 occurred in 2012 (Table 3-10) harvesting 97 by purse seines and 23,219 by gill nets.

First Nations FSC (Area 21/22), ESSR (Area 22) harvest of Chum salmon in 2012 totaled 20,902 Chum. An additional 39,024 Chum salmon were taken for broodstock at Nitinat, and 10,790 Chum salmon were harvested by the gill net test fishery in Nitinat Lake. Recreational fisheries targeting Chum salmon are very limited; harvest in 2012 was not estimated but was assumed to be very small (~100 Chum salmon). All Chum salmon removals (i.e. all harvest plus broodstock collections) totaled 99,132 Chum salmon in 2012 (Table 3-10).

Table 3-10. Nitinat area harvest, hatchery broodstock collection and spawning escapement estimates by PFMA, 2003–2012.

Year	Area 21		Area 22	
	Seine Net Harvest	Gill Net Harvest	In-Lake Harvest & Broodstock	Escapement [1] (Natural Spawners)
2003	250,069	185,086	78,238	247,804
2004	74,613	162,933	166,200	247,368
2005	385,487	294,054	237,200	315,789
2006	223,927	229,243	145,000	155,053
2007	0	180,111	22,268	115,789
2008	18,796	23,919	34,505	52,632
2009	0	0	32,434	54,000
2010	0	0	43,000	59,900
2011	211,968	65,469	137,321	248,655
2012	97	23,219	75,816	206,704
Average	116,496	116,403	97,380	170,369

(1) includes Nitinat tributaries.

3.5 Escapement

Chum salmon that escape First Nations, commercial (including test fisheries), and recreational fisheries, and any First Nations ESSR harvests, form the escapement totals of spawning Chum salmon for this section of the report. This *net escapement* can include Chum salmon that spawn in natural areas and constructed spawning channels, and those that are used as broodstock in enhancement facilities for hatchery production purposes. For the purposes of this report *spawning escapement* refers to salmon that spawn by their own volition in nature in either a natural (e.g. river) or manmade channel (e.g. controlled spawning channel), and does not include salmon used for broodstock.

Some river systems in southern B.C. support summer Chum salmon populations. However, because the summer aggregate is relatively minor when compared to the larger fall aggregate in southern B.C., and due to their distinctively early run timing (e.g. July to late August in Johnstone Strait) allowing for only a minimal bycatch in southern B.C. salmon fisheries (Table 3-4), summer Chum salmon escapement is not included in the escapement totals for this section of the report (i.e. escapement totals in this section refer to fall Chum salmon only).

3.5.1 Inside Southern

The stocks that are managed within the context of the ISC salmon plan are the fall Chum salmon. These Chum salmon enter Johnstone Strait during the September to November time period. Escapement estimates for these Chum salmon since 2002, are presented in Table 3-11.

Table 3-11. Inside Southern Chum salmon net escapement estimates (spawning escapement plus hatchery broodstock) for Fraser and Non-Fraser stock aggregates, 2003–2012 [1].

Year	Inside Southern Chum Escapement		
	Fraser River	Non-Fraser River	Total
2003	1,451,961	777,956	2,229,917
2004	2,633,549	1,009,417	3,642,966
2005	1,264,071	558,309	1,822,380
2006	2,026,673	747,654	2,774,327
2007	1,026,701	905,080	1,931,781
2008	940,143	707,731	1,647,874
2009	619,363	860,704	1,480,067
2010	634,493	419,068	1,053,561
2011	1,084,652	923,451	2,008,103
2012	1,280,332	1,326,848	2,607,180
Average	1,296,194	823,622	2,119,816

(1) Does not include Chum salmon which are surplus to spawning requirements (ESSR) and are removed from the spawning areas as they do not contribute to production in subsequent years. Those Chum salmon are assigned to harvest. Hatchery broodstock removals are included as they contribute to subsequent production.

The primary enhanced escapement areas for Inside Southern Chum salmon are presently limited to the mid-Vancouver Island, Squamish River, Burrard Inlet and Fraser River areas. The enhancement facilities in the mid-Vancouver Island consist of Big Qualicum, Little Qualicum and Puntledge River Hatcheries. There is one enhancement facility in the Burrard Inlet (Capilano River Hatchery: limited Chum salmon hatchery production), and the Squamish watershed (Tenderfoot Creek Hatchery) and four in the Fraser River watershed (Inch Creek, Chilliwack River, and Chehalis River Hatcheries and Weaver Creek Spawning Channel). Enhancement on the Capilano is opportunistic, only using Chum salmon that return to the hatchery facility for broodstock.

3.5.2 West Coast Vancouver Island

In 2012, Nitinat Chum salmon spawning escapement was estimated at 207,000 (Table 3-10) which is a reduction compared to the 2011 return but still an improvement over the previous trend of low spawning escapement that ran from 2008-2010. In other WCVI Areas, Chum salmon spawning escapements were poor and below average in all areas except Area 26 (Table 3-12). Spawning escapement estimates given for Areas 23-26 in Table 3-12 are derived from

index system assessments in each Area. From historical surveys of Chum salmon streams in each Area, the proportion each stream contributed (on average) to the total spawning escapement for the Area is estimated. Spawning escapement estimates from index systems currently surveyed annually, are expanded to an Area spawning escapement to account for those streams not surveyed.

Table 3-12. WCVI Chum salmon spawning escapement estimates[1] by PFMA, 2003–2012.

Year	WCVI Pacific Fishery Management Area			
	Area 23 (Barkley)	Area 24 (Clayoquot)	Area 25[2] (Nootka)	Area 26 (Kyuquot)
2003	115,974	80,787	118,265	70,228
2004	100,384	141,646	220,772	69,606
2005	79,655	56,544	97,709	51,300
2006	21,820	120,395	58,639	71,131
2007	45,013	78,272	19,022	82,775
2008	22,716	29,113	29,180	30,019
2009	29,690	32,190	78,393	29,839
2010	24,977	43,774	59,826	33,650
2011	123,816	121,259	69,497	85,099
2012	52,650	43,484	25,036	98,188
Average	61,670	74,746	77,634	62,184

(1) Index system spawning escapements expanded to total spawning escapement for the Area.
(2) Nootka spawning escapements include hatchery river systems.

4 United States Chum salmon

4.1 Washington Run Sizes, Catches, and Spawning Escapements

Tables 4-1 through 4-3 provide pre-season forecasts of run size, post-season estimates of run size and post-season estimates of spawning escapement for the Chum salmon runs returning to Puget Sound and coastal Washington areas. The tables present estimates for three major Chum salmon groupings, defined by their return timings (summer Table 4-1, fall Table 4-2, and winter Table 4-3).

Summer Chum

The Strait of Juan de Fuca summer Chum salmon post-season run size of 5,408 was slightly below the pre-season forecast and was 82% of the 2003-2012 average post season runsize (Table 4-1, Figure 4-1). The Hood Canal summer Chum salmon run size of 41,269 was more than 4 times the pre-season forecast and was 149% of the 2003 – 2012 average post-season run size. Approximately 77% of the combined Strait of Juan de Fuca and Hood Canal summer Chum salmon run went to escapement. The summer Chum salmon pre-season forecast for South Puget Sound for 2011 was estimated at approximately 42,000 fish, which is 70% of the average return for the recent 10-year period. The post-season run size estimate of South Puget Sound summer Chum salmon in 2012 was 38,936 fish, or 93% of the pre-season forecast, and was 65% of the 2003-2012 average post-season run size (Table 4-1, Figure 4-1).

Table 4-1. Puget Sound summer Chum salmon pre-and post-season estimates of run size and spawning escapements, 2003--2012.

Region	Type	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Strait of Juan de Fuca	Pre-Season	3,131	4,739	6,803	8,238	8,566	5,969	5,198	3,991	5,308	5,915
	Post-Season	7,017	9,360	9,735	8,281	3,326	3,576	5,148	9,332	5,704	5,408
	Escapement	6,959	9,341	9,682	8,246	3,295	3,525	5,115	9,261	5,675	5,403
Hood Canal	Pre-Season	10,128	18,078	18,060	19,780	23,729	20,159	18,009	5,998	9,050	8,970
	Post-Season	36,024	95,077	16,165	29,396	12,811	17,622	8,425	12,951	7,298	41,269
	Escapement	35,696	69,995	15,757	26,753	10,781	15,403	7,423	12,742	6,972	30,613
South Puget Sound [1]	Pre-Season	47,788	99,317	38,334	55,300	39,840	64,229	57,352	62,991	62,623	41,889
	Post-Season	49,817	178,199	44,993	78,797	57,786	32,065	25,010	49,098	39,823	38,936
	Escapement	45,945	120,782	24,701	63,345	52,669	20,872	21,659	65,888	38,517	24,522

(1) South Puget Sound estimates include only commercial harvest and escapement within Puget Sound.

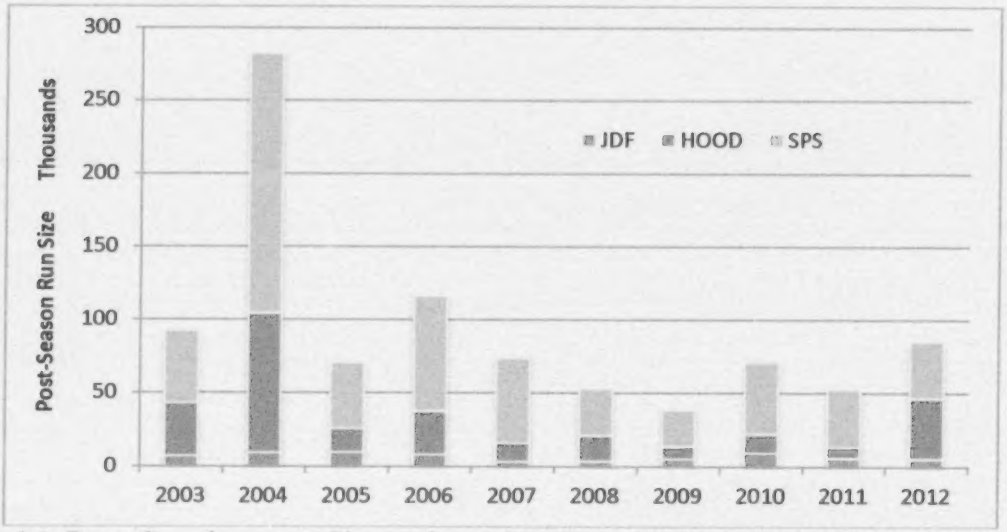

Figure 4-1. Puget Sound summer Chum salmon abundance, 2003-2012, by region of origin (JDF: Strait of Juan de Fuca, HOOD: Hood Canal, SPS: South Puget Sound).

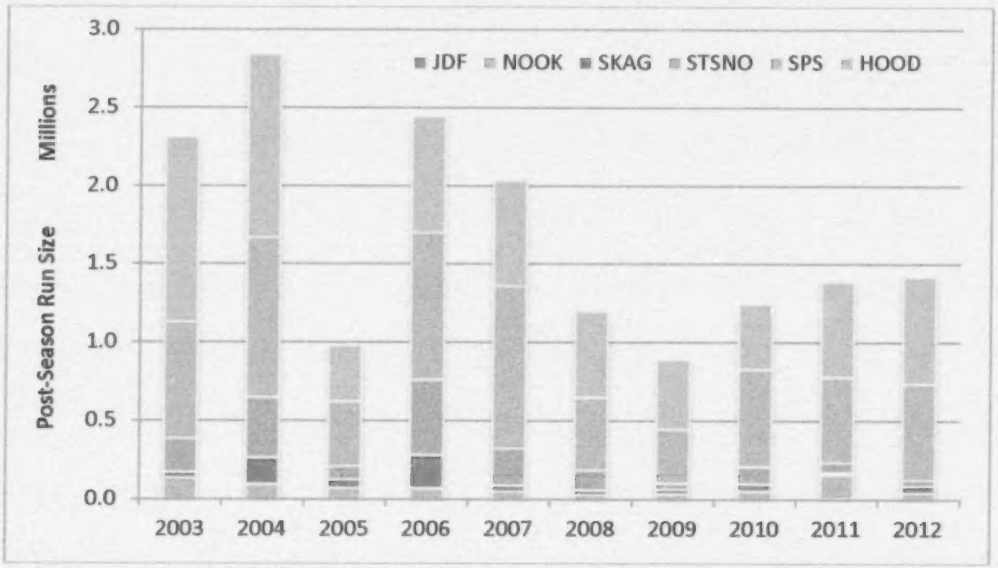

Figure 4-2. Puget Sound fall Chum salmon abundance, 2003-2012, by region of origin (JDF: Strait of Juan de Fuca, NOOK: Nooksack-Samish, SKAG: Skagit, STSNO: Stillaguamish/Snohomish, SPS: South Puget Sound, HOOD: Hood Canal).

Fall Chum

The Puget Sound fall Chum salmon post-season assessment total was 1,422,084 fish, or 153% of the preseason forecast and was approximately 85% of the 2003−2012 average run size. Individual regional post-season numbers varied in their deviation from the forecasted numbers, ranging from 189% (South Sound) to 46% (Stilly/Snohomish) of the pre-season forecasted

numbers (Table 4-2, Figure 4-2). The Washington coastal (Willapa Bay and Grays Harbor) fall Chum salmon post-season assessment total was 83,197 fish, or approximately 150% of the preseason forecast and was 113% of the 2003-2012 average run size

Winter Chum

The winter Chum salmon 2012 post-season run size assessment for South Puget Sound was 25,522, or approximately 50% of the preseason forecast and was 31% of the 2003-2012 average run size (Table 4-3, Figure 4-3).

Paragraph 3 of the Chapter 6, Annex IV of the Treaty requires that Canada and the United States assess catch levels of summer Chum salmon caught during the August 1 through September 15 time period in boundary area fisheries. Table 4-4 provides Chum salmon harvest during this summer Chum salmon accounting period for U.S. boundary area fisheries. Table 4-5 provides Chum salmon harvest information from the Strait of Juan de Fuca (SJF) fisheries in Areas 4B, 5, and 6C and the San Juan Islands/Point Roberts (SJI/PR) fisheries in Areas 7 and 7A (Appendix B1). Table 4-5 also includes annual Chum salmon harvest totals for the Puget Sound and the Washington Coastal areas.

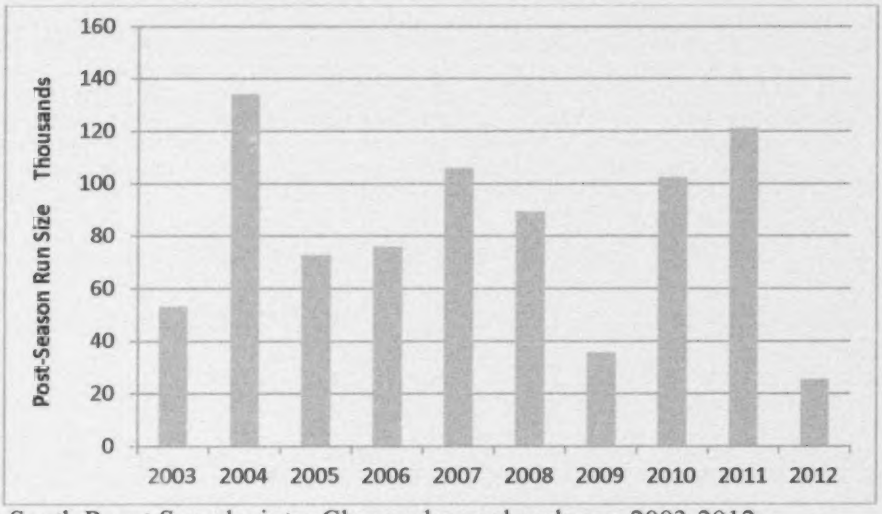

Figure 4-3. South Puget Sound winter Chum salmon abundance, 2003-2012.

Table 4-2. Washington fall Chum salmon pre-and post-season estimates of run size and spawning escapements, 2003–2012.

Region	Type	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Willapa Bay	Pre-Season	75,817	79,183	63,441	38,754	23,798	40,022	7,139	33,442	22,254	28,273
	Post-Season	84,772	114,756	28,132	23,483	17,678	12,982	17,437	26,726	69,793	42,636
	Escapement	47,797	84,926	11,983	15,250	17,392	9,511	12,743	25,212	66,876	26,559
Grays Harbor	Pre-Season	66,312	45,352	38,038	29,370	12,000	9,903	17,665	18,492	33,669	24,603
	Post-Season	49,784	34,274	20,596	15,786	12,136	8,879	19,776	43,582	50,494	40,561
	Escapement	38,813	17,494	13,483	11,268	11,342	6,249	15,216	34,644	30,101	27,876
Strait of Juan de Fuca	Pre-Season	2,494	2,438	3,460	3,830	2,143	2,745	2,587	2,222	1,618	1,203
	Post-Season	1,178	3,233	2,382	1,567	769	841	1,462	1,849	4,839	3,174
	Escapement	1,071	2,739	2,034	1,313	503	454	1,305	1,343	4,707	2,973
Nooksack/ Samish	Pre-Season	81,921	78,484	126,869	135,100	19,414	130,070	69,145	61,827	31,924	34,739
	Post-Season	133,680	89,901	67,657	66,610	48,631	27,471	32,007	48,895	152,166	39,080
	Escapement	112,682	53,563	47,644	29,289	21,571	16,257	26,267	30,509	77,995	21,684
Skagit	Pre-Season	52,410	109,715	25,695	164,094	90,481	132,036	26,828	50,226	26,834	59,167
	Post-Season	37,217	171,200	53,672	213,490	37,627	29,946	29,479	46,149	15,851	41,600
	Escapement	18,017	150,196	34,600	105,239	19,576	22,552	26,744	39,911	15,494	36,601
Stillaguamish/ Snohomish	Pre-Season	245,246	264,542	225,113	445,800	287,993	229,251	92,477	90,660	71,277	86,598
	Post-Season	214,609	382,872	84,791	479,987	235,799	125,064	37,689	109,358	61,580	40,002
	Escapement	172,354	212,463	38,788	272,925	43,664	38,553	29,378	46,628	60,792	35,450
South Puget Sound	Pre-Season	448,365	470,048	655,742	466,700	408,040	686,511	348,333	650,986	487,514	323,928
	Post-Season	742,940	1,022,749	414,939	939,638	1,036,774	464,193	344,854	623,197	545,192	613,564
	Escapement	316,816	356,712	137,442	369,035	369,455	152,579	150,887	201,992	175,989	191,290
Hood Canal	Pre-Season	342,061	501,100	749,593	668,400	587,155	668,397	374,929	477,409	352,019	426,675
	Post-Season	1,183,289	1,173,077	356,243	745,675	676,602	553,122	446,476	416,461	611,349	684,662
	Escapement	331,378	229,893	100,242	185,875	162,425	72,012	55,879	49,484	103,383	91,973

Table 4-3. Washington winter Chum salmon pre- and post-season estimates of run size and spawning escapements, 2003–2012.

Region	Type	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
South Puget Sound	Pre-Season	34,575	76,464	142,406	149,200	81,065	98,922	83,380	89,293	55,923	51,599
	Post-Season	53,112	134,002	72,730	75,833	105,933	89,271	35,544	102,235	121,079	25,522
	Escapement	49,050	98,580	43,908	58,786	73,442	45,162	15,486	79,550	74,110	18,987

Table 4-4. Harvest of Chum salmon in the Strait of Juan de Fuca (SJF) and the San Juan Islands (SJI) commercial fisheries during the summer Chum salmon accounting period, July 1–September 15, 2003–2012.

Year	Time Period [1]					Yearly Total
	7/1–8/18	8/19–8/25	8/26–9/1	9/2–9/8	9/9–9/15	
95–97 GSI [2]	0.68	0.40	0.45	0.14	0.07	
2003	331	74			12	417
2004	162		15	31	25	233
2005	29	17	17	3	16	82
2006	98	58	10	8	3	177
2007	39				9	48
2008	240	1			29	270
2009	13			17	52	82
2010	66	140	46	39	6	297
2011	31		3	27	20	81
2012	135					135
Averages	114	58	18	21	19	182

(1) Indicates cumulative catch of chum salmon through this period (GSI not applied to values). Time period notation is month/day (e.g. 7/1-8/11 refers to July 1 to August 11).

(2) Estimated proportions of Hood Canal/Juan de Fuca summer Chum salmon from GSI from 1995–1997.

Table 4-5. Harvest of summer, fall, and winter Chum salmon in SJF, SJI/PR, Puget Sound and Washington coastal areas, 2003–2012 [1].

Year	Region			
	SJF (Areas 4B, 5, 6C)	SJI/PR (Areas 7, 7A)	Puget Sound [2]	WA Coast [3]
2003	407	84,009	1,389,446	49,789
2004	4,923	166,441	2,076,014	48,045
2005	1,768	77,606	668,499	23,870
2006	4,478	106,634	1,569,033	13,532
2007	6,697	27,397	1,443,464	2,728
2008	5,695	75,374	961,481	7,067
2009	742	24,244	637,485	10,351
2010	1,938	23,652	949,853	12,593
2011	1,867	70,363	1,009,556	28,251
2012	546	73,255	1,083,872	30,697
Averages	2,906	72,898	1,178,870	22,692

(1) Includes recreational harvest: 2012 harvest estimates are preliminary.

(2) All other Puget Sound freshwater and marine harvest areas except Strait of Juan de Fuca or San Juan Islands/Point Roberts Fisheries.

(3) WA Coast combines harvest from Areas 1–4 including Grays Harbor, Willapa Bay, Columbia River and Coastal Rivers.

4.2 United States Strait of Juan de Fuca Fisheries (Areas 4B, 5, 6C)

4.2.1 Management Intent

During the 2012 season the management strategy for the Strait of Juan de Fuca (SJF) fishery consisted of maintaining reduced effort in this fishery and basing management decisions on the needs of Puget Sound stocks of Chum salmon. The regime of this fishery has been relatively stable and limited to four Treaty Indian Tribes using gill net gear only.

This fishery has experienced minimal effort in recent years, resulting in relatively modest harvest levels over the period of 2003–2012 (Table 4-5). Harvest and effort for the period of 2003–2012 was well below levels observed in the late 1980s and 1990s.

4.2.2 Fishery Description

The fall Chum salmon fishery opened the week of October 7, 2012 with a schedule of 6 days per week and continued through November 10, 2012. As in previous years, the fishery in Areas 4B, 5 and 6C was restricted to Treaty Indian fishers using gill nets. A total of 348 Chum salmon was harvested in this Treaty Indian fishery. An additional Chum salmon were harvested in recreational fisheries, resulting in a total harvest estimate of 546 Chum salmon for the Chum salmon-directed management period. During the fall Chum fisheries in Areas 4B, 5, and 6C, there was a reported by-catch of 21 Steelhead; 3,749 Coho; and one Chinook.

Incidental harvests of Chum salmon prior to the Chum salmon-directed fishing season was relatively low in contrast to the recent 10 year average (Table 4-4). A total of 135 Chum salmon, including those harvested in SJF test fisheries, were recorded through September 15, 2012, during the summer Chum salmon accounting period (July 1 – September 15). During the subsequent Coho salmon-directed fishery, an additional 11 Chum salmon were harvested.

The total annual harvest for SJF in 2012 was 546 Chum salmon (Table 4-5).

4.3 San Juan Islands / Point Roberts Fisheries (Areas 7 and 7A)

4.3.1 Management Intent

Chum salmon fisheries in Areas 7 and 7A are regulated to comply with a base harvest ceiling of 130,000 Chum salmon, unless a critically low level of abundance (< 1,000,000) is identified for those populations migrating through Johnstone Strait (Inside Chum salmon). Chapter 6, Annex IV, specifies that Chum salmon-directed fishing is not allowed in Areas 7 and 7A before October 10. Paragraph 10 (a-b) specifies that for run sizes below the critical threshold, harvest of Chum salmon in Areas 7 and 7A will be limited to those taken incidentally to other species and in other minor fisheries, and shall not exceed 20,000.

4.3.2 Fishery Description

An estimated Fraser River Chum salmon run size was provided by Canada on October 16, with an estimate of 1,900,000.

The U.S. Chum salmon fishery which had begun on October 10th continued through November 14th with weekly catch monitoring. The U.S. catch between October 10 and November14 in Areas 7 and 7A was 70,986 Chum salmon. The Non-Treaty gill net and purse seine fleets were open daily October 11, 14, 15, 17, 18, and then open continuously from October 21 through November 10. The Treaty Indian gill net and purse seine fisheries were opened on October 10, 12, 13, 16, 19, 20, and then ran continuously from October 22 through November 14. Catches per vessel and effort were good throughout the fishery.

Non-Indian reef net fisheries targeting adipose-marked Coho salmon were conducted from the end of Fraser Panel control (September 2), until September 30, with Chum salmon retention prohibited. From October 1 through November 12, reefnets were open daily with Chum salmon retention allowed. Chum salmon catch in this fishery, between October 1 and October 10, was 2804 fish. There was no reef net fishing effort after early October.

There were 11 Chum salmon reported caught in Areas 7 and 7A during Fraser Panel approved Sockeye and Pink salmon fisheries in August and early September. The total 2012 Chum salmon catch by all gears (including recreational) in Areas 6, 7, and 7A, reported through November 15, was 70,480. Catch distribution, between Areas 7 and 7A, was 66% and 34%, respectively. During the fall Chum salmon fisheries in Areas 6, 7, and 7A, there was a reported by-catch of 5 Chinook and 9,594 Coho salmon and zero Steelhead.

5 Stock Identification

5.1 Tagging of Adult Chum Salmon

No adult tagging projects were reported by either Canada or the United States in marine or nearshore areas in 2012.

5.2 Otolith, Fin Marking and Coded Wire Tagging (CWT)

5.2.1 Canada

Thermal marking of otoliths (Volk *et al.* 1987) has been used to mass mark hatchery raised salmonids in B.C. since the early 1990's (Hargreaves *et al.* 2001). The method involves manipulating the temperature of the rearing water by at least 2°C to induce lighter or darker deposition (density) of otolith layers. By systematically altering water temperature over a period of time, banding patterns (i.e. a "mark") unique to each hatchery can be created.

Thermal marking was first used on Chum salmon at Nitinat Hatchery on the West Coast of Vancouver Island in 1993 and continues to be used as a means of estimating hatchery contribution to both fisheries and escapement. Thermal marking is currently the only mark being applied to Chum salmon from Nitinat hatchery (Table 5-1). Transplanting thermally-marked Chum salmon into Klanawa River started with the 2001 brood and ended with the 2006 brood year (Table 5-1).

Table 5-1. Releases of Chum salmon with thermally-marked otoliths from WCVI based Canadian hatchery facilities, 2003–2012

Brood Year	Nitinat Hatchery Release Sites		Conuma Hatchery Release Sites					
	Nitinat River & Lake	Klanawa River	Conuma River	Conuma Estuary	Tlupana River	Sucowa River	Canton River	Deserted River
2003	21,252,421	2,516,338	-	1,585,534	425,261	410,872	484,570	798,330
2004	32,684,608	2,631,539	-	1,882,230	932,556	1,023,658	679,554	-
2005	36,724,205	2,739,742	-	914,381	744,834	256,296	434,449	-
2006	26,323,943	2,585,428	-	1,455,119	1,139,028	181,333	133,731	-
2007	13,004,189	-	-	271,820	109,922	15,701	47,846	-
2008	7,631,058	-	-	1,011,562	254,905	292,430	418,655	-
2009	5,252,749	-	-	1,833,322	685,465	551,365	854,548	-
2010	14,182,582	-	-	1,794,205	1,015,355	311,828	646,203	-
2011	25,303,286	-	-	1,270,286	37,241	223,882	365,682	-
2012	15,813,000			785,682	813,957	41,196	116,757	

A second hatchery on the West Coast of Vancouver Island, Conuma Hatchery, first began thermally marking otoliths for several populations of Chum salmon beginning with the 1998 broodyear. This continued in 2012 with extensive releases of thermally-marked Chum salmon in various river systems of Nootka Sound (Table 5-1). Similar to Nitinat releases, comprehensive adult sampling programs aimed at detecting (i.e. recapturing) the thermally-marked Chum salmon have occurred during the fall Chum salmon fisheries. Information from these programs has permitted a better understanding of timing and catch distribution for the Chum salmon populations in Nootka Sound.

Table 5-2. Releases of marked Chum salmon from southern B.C. based Canadian hatchery facilities, 2003 to 2012

Population	Broodyear	Fin Clip Type[1]	Clipped	Poor Clips + Unclipped	Total
Big Qualicum River	2003	ADRV	251,939	4,856	256,795
	2004	ADRV	261,366	6,579	267,945
	2005	ADRV	252,585	9,775	262,360
	2006	ADRV	252,016	6,853	258,869
	2007	ADRV	251,329	9,471	260,800
	2008	ADRV	204,801	5,409	210,210
	2009	ADRV	250,692	8,381	259,073
	2010	ADRV	201,825	5,463	207,288
	2011	AD	250,337	4,011	254,348
	2012	AD	249,655	3,636	253,291
Salloomt River	2003	LV	103,148	1,054	104,202
Theodosia River	2002	LV	101,029	0	101,029
Sugsaw Creek	2003	LV	11,000	0	11,000
	2004	LV	20,600	0	20,600

(1) Clip Types: AD-adipose fin; LV-left ventral fin; RV-right ventral fin.

Not all release groups were represented by a mark. Contributions to fisheries and escapement for those groups were estimated by associating them with a marked release group having a similar size and release timing. Table 5-2 provides a summary of mark/tag combinations applied from 2003-2012 brood years. Big Qualicum River is the only population that had any fin-clipped Chum salmon releases in 2012 (Table 5-2).

There were no coded wire tagged Chum released from Canadian facilities during the 2003-2012 time period.

5.2.2 United States

Otolith marking (Volk *et al.* 1987) was used in several hatchery supplementation and re-introduction programs for summer Chum salmon in the Hood Canal and Strait of Juan de Fuca regions (Table 5-3), and for fall Chum salmon in Puget Sound and the Lower Columbia River (Table 5-4). Otolith marking was used as a tool to assess program success and determine proportions of hatchery- and natural-origin fish (and identify hatchery strays) on spawning grounds. Releases of supplementation summer Chum salmon for recovery and reintroduction ended at Discovery, Chimacum, and Union with brood year 2003.

Table 5-3. Numbers of Hood Canal summer Chum salmon released with thermally-marked otoliths or an adipose fin clip by brood year, 2003–2012 (Point No Point Treaty Tribes and Washington Department of Fish and Wildlife 2014)

Brood Year	Hood Canal Summer Chum Salmon								
	Jimmycome-lately	Discovery Bay[1]	Chimacum[1]	Big Beef	Big Quilcene[2]	Hamma Hamma	Lilliwaup	Union	Tahuya
2003	50,307	88,610	57,435	76,353	92,559	75,356	103,913	35,343	-
2004	76,982	-	-	14,814	-	57,000	99,500	-	118,872
2005	57,300	-	-	-	-	117,837	106,466	-	119,260
2006	79,428	-	-	-	-	151,550	88,800	-	133,826
2007	73,840	-	-	-	-	48,530	0	-	53,632
2008	88,766	-	-	-	-	208,450	68,810	-	97,142
2009	92,200	-	-	-	-	-	140,210	-	69,711
2010	85,630	-	-	-	-	-	139,816	-	27,706
2011	-	-	-	-	-	-	41,006	-	19,600
2012	-	-	-	-	-	-	157,760	-	110,000

(1) Discovery Bay is Salmon and Snow creeks combined and broodstock were released in Chimacum for reintroduction, program discontinued after brood year 2003.
(2) Adipose fin clipped only; no thermally-marked otoliths.

A summer Chum salmon supplementation program was started in 1992 at the Quilcene National Fish Hatchery to address severe declines in the numbers of summer Chum salmon returning to the Quilcene River and for reintroduction in Big Beef Creek. After 1997, an adipose fin clip (with no CWT) was used to identify Quilcene hatchery fish for terminal fisheries management and for project evaluation. Brood year 2003 was the final year summer Chum salmon were marked and released from Quilcene National Fish Hatchery (Table 5-3).

Table 5-4. Numbers of Puget Sound and Lower Columbia River fall Chum salmon released with thermally-marked otoliths or an adipose fin clip by brood year, 2003–2012

	Puget Sound	Lower Columbia River		
Brood Year	Whatcom Creek	Grays River Hatchery[1]	Sea Resources Hatchery	Washougal Hatchery
2003	-	357,000	102,132	75,952
2004	-	163,000	-	-
2005	-	155,501	-	19,578
2006	-	129,427	-	-
2007	450,000	77,609	-	-
2008	400,000	104,600	-	-
2009	-	300,000	-	70,000
2010	2,000,000	2,365,271	-	57,455
2011	1,360,000	206,000	-	74,893
2012	1,547,900	157,800	-	58,004

(1) Includes Grays River brood stock released in Big Creek, OR.

5.3 Genetic Stock Identification

In 2010, the Committee completed a joint recommendation to the Southern Panel concerning the type of stock identification methodology to be used for immediate and future application of Canada and United States (U.S.) Chum salmon stock assessment (Appendix C). The Pacific Salmon Treaty (Annex IV, Chapter 6, Section 2) states:

> *"When the Parties provide stock composition information for fisheries, the Committee shall evaluate and report its conclusions using bilaterally agreed upon methods."*

Fisheries of interest include Johnstone Strait, Qualicum, Fraser River, and Nitinat in Canada and Point Roberts, San Juan Islands and the Strait of Juan de Fuca in the U.S.

5.3.1 Fishery Sample Collection for Genetic Stock Identification

5.3.1.1 Canada

GSI samples were collected during the Johnstone Straits purse seine fisheries (commercial and test fishery) in 2012 (Table 5-5). In 2012, these samples were analysed for microsatellite markers using the first year of four years of funding supported by the Southern Endowment Funds (Van Will et al. 2013)

Table 5-5. Chum salmon tissue samples collected in Johnstone Strait fisheries and analyzed for GSI, 2002–2012.

Year	Commercial Samples		Test Fishery Samples	
	Collected	Analyzed	Collected	Analyzed
2003	600	600	0	0
2004	600	600	0	0
2005	0	0	0	0
2006	716	714	0	0
2007	879	869	0	0
2008	995	868	830	449
2009	1418	1101	999	0
2010	400	400	1015	1114
2011	865	863	1404	905
2012	987	935	1275	1261

5.3.1.2 United States

Among focused studies, WDFW used GSI to distinguish supplementation- and natural-origin adult summer Chum salmon in Hood Canal as part of the effort to monitor the Hood Canal summer Chum salmon recovery program. For instance, from 2006-2009 mSAT DNA data were used to clarify uncertain hatchery assignments generated from broken otoliths or ambiguous otolith thermal marks. Each supplementation program for summer Chum salmon had unique otolith marks (except for Quilcene fish which were fin-clipped), but some otoliths broke and in

some years there was ambiguity between thermal marks for some programs. Spawners could be identified as supplementation- or natural-origin, but not identified to their program of origin.

These fish were genotyped and identified by assigning them to populations in the Hood Canal summer Chum salmon genetic baseline. Genetic analysis was used to evaluate impacts of supplementation on the Hood Canal summer Chum salmon metapopulation (Small et al. 2009). WDFW also conducted juvenile stock assignment studies in the Strait of Juan de Fuca and Hood Canal during 2009, 2010, and 2011. The juvenile studies documented emigration timing and relative production of summer and fall Chum salmon in key populations. Further, 981 tissue samples were collected near Apple Cove Point in Puget Sound Area 9 in the sixth year of Chum salmon DNA collection from this test fishery.

Fisheries sampling in Area 7 and Area 7a was sampled and analyzed from the first of four years of Southern Endowment Funding project using microsatellites (Van Will et al. 2013).

Table 5-6. Chum salmon tissue samples collected in Areas 7 and 7a analyzed for GSI in 2012-2013.

Year	Area 7	Area 7A
2012	1,328	829
2013	419	423

5.3.2 Baseline Collection for Genetic Stock Identification

5.3.2.2 Canada

In 2012, CDFO continued to collect baseline GSI tissue samples of Southern British Columbia Chum salmon populations (Table 5-7).

Table 5-7. Fall Chum salmon GSI tissue collections from Southern B.C. by Conservation Unit, collection site, life stage, and influence [1] of enhancement, 2012.

Conservation Unit	Collection Site	Life Stage	Enhancement Level 1	Sample Size
Howe Sound-Burrard Inlet	Indian River	Adult	Natural	247
Loughborough	Phillips River	Adult	Natural	77
Southwest Vancouver Island	Sucwoa River	Adult	Enhanced	99
Southwest Vancouver Island	Canton River	Adult	Enhanced	101
Total				433

(1) Enhancement level refers to the degree to which the CDFO Committee members believed hatchery production contributed to the returns to the collection site. Based partly on the enhancement history in the CDFO hatchery production database, enhancement level is subjectively classified as either *hatchery* (insignificant contribution of natural production to returns), *mixed* (both enhanced and natural production contribute significantly to returns) or *natural* (insignificant contribution of hatchery production to returns).

5.3.2.1 *United States*

During 2012, WDFW and Washington Treaty Tribes continued baseline sampling of Washington State populations of Chum salmon (Table 5-8). Tissues were archived for future genotyping and will be added to the genetic baseline.

Table 5-8. Summer, fall and winter Chum salmon GSI tissue collections from WA State, 2012.

Collection Site / Run group / Locality	Enhancement Level[1]	Sample Size
Puyallup Hatchery	hatchery	81
Grovers Creek - fall	natural	51
Stillaguamish River-fall	natural	236
Tulalip Hatchery	hatchery	100
Snohomish	natural	106
Total		547

(1) Enhancement level refers to the degree to which the U.S. Committee members believed hatchery production contributed to the returns to the collection site: *hatchery* (insignificant contribution of natural production to returns), *mixed* (both enhanced and natural production contribute significantly to returns) or *natural* (insignificant contribution of hatchery production to returns).

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APPENDICES

Appendix A. ANNEX IV, CHAPTER 6, OF THE PACIFIC SALMON TREATY

Southern British Columbia and Washington State Chum Salmon

The provisions of this Chapter shall apply for the period 2010 through 2018.

1. The Parties shall maintain a Joint Chum Technical Committee ("the Committee") reporting, unless otherwise agreed, to the Southern Panel and the Commission. The Committee will undertake to, *inter alia*:

    a) maintain and present historical catch and escapement information for stocks relevant to the Treaty;

    b) utilize available information to estimate and document stock composition and exploitation rates in fisheries of concern to the Treaty;

    c) review annually the Parties' assessment of stock status and fisheries activities for Chum fisheries of concern to the Treaty;

    d) identify high priority research and information needs for the Parties, including fishery and escapement monitoring and assessment, stock identification, and enhancement; and

    e) periodically and/or when requested;

        i. Exchange available information on the productivity and escapement requirements of stocks relevant to the treaty;

        ii. Identify and document stocks of concern (with respect to conservation) relevant to the treaty;

        iii. Evaluate the effectiveness and performance of management strategies; and

        iv. Evaluate the effectiveness of alternative regulatory and production strategies recommended by the Parties.

2. When the Parties provide stock composition information for fisheries, the Committee shall evaluate and report its conclusions using bilaterally agreed upon methods.

3. Canada and the United States shall assess catch levels and make attempts to collect additional genetic samples from any Chum salmon caught during the July 1 through September 15 time period in the Boundary Area fisheries (U.S. Areas 4B, 5, 6C, 7 and 7A; Canadian Areas 18, 19, 20, 21, and 29).

4. During the period from July 1 through September 15, Canada will require the live release of Chum salmon from all purse seine gear fishing in the Strait of Juan de Fuca (Canadian Area 20) and the United States will require the same for the non-Indian seine fisheries in Areas 7 and 7A. Note: By U.S. regulation, purse seine fisheries are not permitted in U.S. Areas 4B, 5 and 6C.

5. Canada will manage its Johnstone Strait, Strait of Georgia, and Fraser River Chum salmon fisheries to provide continued rebuilding of depressed naturally spawning Chum salmon stocks, and, to the extent practicable, not increase interceptions of U.S. origin Chum salmon. Terminal fisheries conducted on specific stocks with identified surpluses will be managed to minimize interception of non-targeted stocks.

6. Canada will manage its Johnstone Strait mixed stock fishery as follows:

   a) Inside Southern Chum salmon levels of less than 1.0 million as estimated by Canada are defined, for purposes of this chapter, as critical;

   b) For run sizes above the critical threshold, Canada will conduct fisheries with an exploitation rate of up to 20% in Johnstone Strait of Inside Southern Chum salmon; and

   c) When run sizes are expected to be below the critical threshold, Canada will notify the United States and will only conduct assessment fisheries and non-commercial fisheries. Commercial fisheries targeting Chum salmon will be suspended.

7. Canada will manage its Fraser River fisheries for Chum salmon as follows:

   a) For Fraser River terminal area run sizes, identified in-season, at abundance levels lower than 900,000 Chum salmon, the Canadian commercial Chum salmon fisheries within the Fraser River and in associated marine areas (Area 29), will be suspended; and

   b) For Fraser River terminal area run sizes, identified in-season at levels greater than 900,000 Chum salmon, Canadian commercial Chum salmon fisheries within the Fraser River, shall be guided by the limits of the in-river Total Allowable Catch set by Canada.

8. Canada will manage the Nitinat gill net and purse seine fisheries for Chum salmon to minimize the harvest of non-targeted stocks.

9. Canada shall conduct a genetic sampling program of Chum salmon taken in the West Coast Vancouver Island troll fishery if early-season catch information indicates that catch totals for the July 1 through September 15 season may reach levels similar to 1985 and 1986. Sampling, should it occur, will include catches taken from the southern areas (Canadian Areas 121-124).

10. The United States will manage its Chum salmon fishery in Areas 7 and 7A as follows:

   a) Inside Southern Chum salmon levels of less than 1.0 million as estimated by Canada are defined, for purposes of this chapter, as critical;

   b) For run sizes below the critical threshold, the U.S. catch of Chum salmon in Areas 7 and 7A shall be limited to Chum salmon taken incidentally to other species and in other minor fisheries, but shall not exceed 20,000, provided that catches for the purpose of genetic stock identification sampling shall not be included in the aforementioned limit;

c) For run sizes above the critical threshold, the base catch ceiling for the U.S. Chum salmon fisheries in Areas 7 and 7A will be 130,000 Chum salmon;

d) Canada will provide a run size estimate of Chum salmon entering the Fraser River no later than October 22. If the estimate is less than 900,000, the U.S. will limit its fishery impacts on Fraser River Chum salmon by restricting catch in Areas 7 and 7A to not exceed 20,000 additional Chum from the day following the date the U.S is notified. The total catch is not to exceed the catch ceiling of 130,000 Chum salmon.

e) U.S. commercial fisheries for fall Chum salmon in Areas 7 and 7A will not occur prior to October 10;

f) The U.S. will manage the Areas 7 and 7A fisheries for Chum salmon with the intent to minimize the harvest of non-targeted species;

g) No U.S. catch shortfalls may be accrued; however any overages shall be carried forward as indicated in (h) and (i);

h) Due to management imprecision, a catch in the U.S. of up to 135,000 Chum salmon will not result in an overage calculation. Catches in excess of 135,000 Chum salmon shall result in an overage being calculated by subtracting 130,000 from the total Chum catch. Overages will be accounted for by reducing the U.S. annual catch ceiling in up to two subsequent non-critical Inside Southern Chum salmon years; and

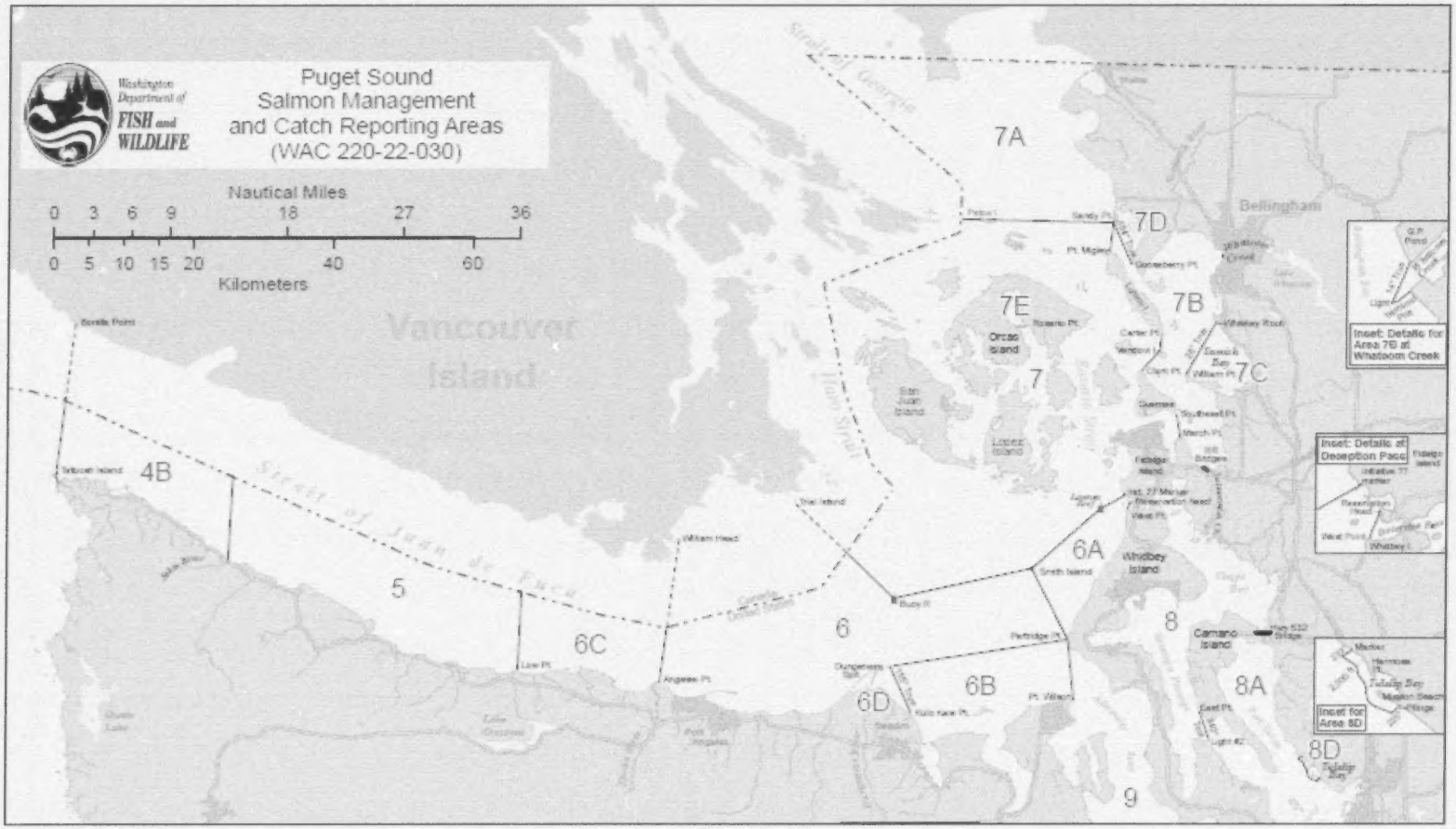
i) From the day following the date the U.S. is notified of a run size below the critical threshold as defined in 10(b) or (d), any catches in excess of 20,000 Chum salmon will result in an overage. Overages will be accounted for by reducing the U.S. annual catch ceilings in up to two subsequent non-critical Inside Southern Chum salmon years.

11. The United States shall conduct its Chum salmon fishery in the Strait of Juan de Fuca (United States Areas 4B, 5, and 6C) so as to maintain the limited effort nature of this fishery, and, to the extent practicable, not increase interceptions of Canadian origin Chum salmon. The United States shall continue to monitor this fishery to determine if recent catch levels indicate an increasing level of interception.

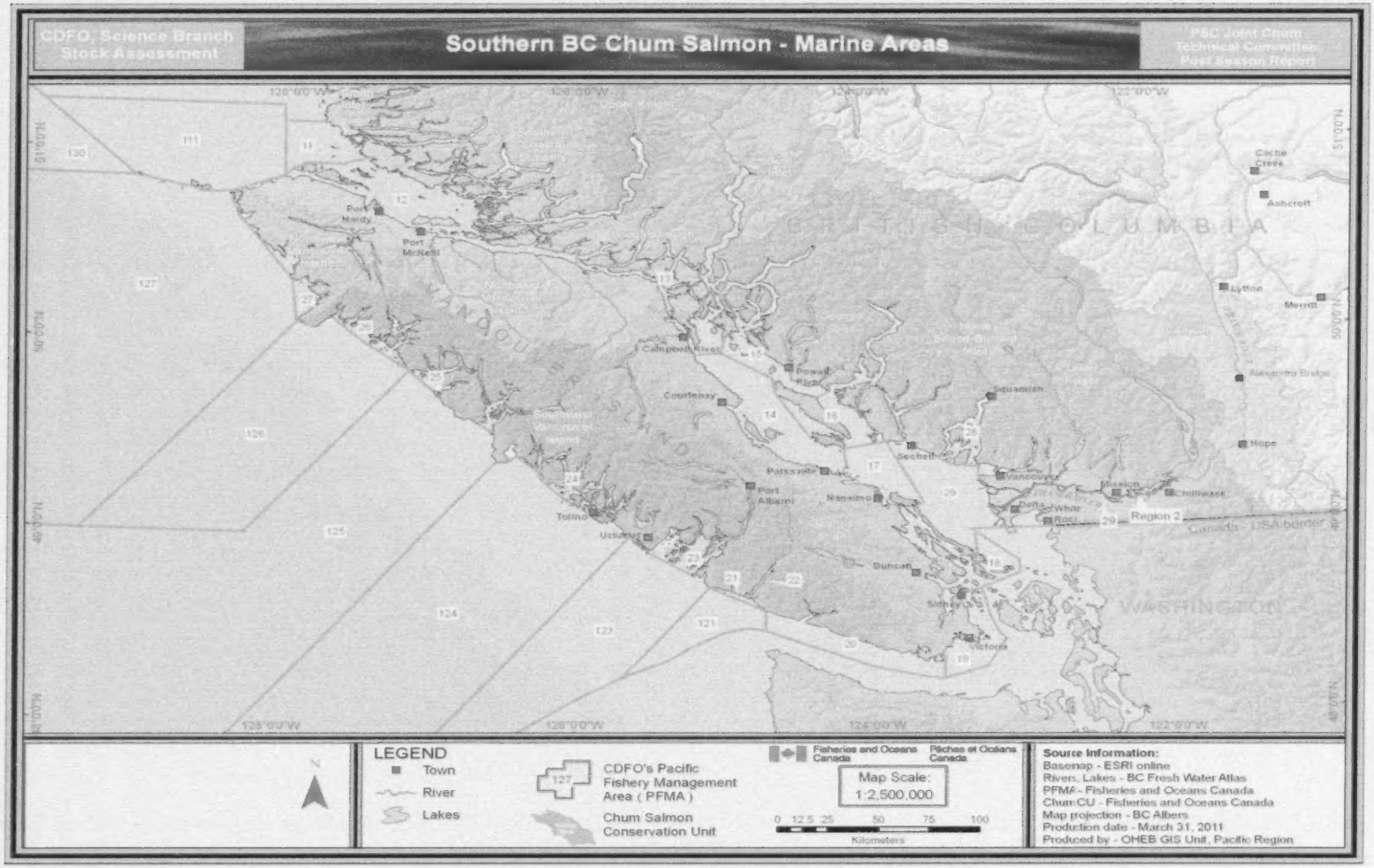
12. All information concerning by-catch of other salmon species from the Chum salmon fisheries covered by this chapter will be shared between the Parties in the annual Post Season Report.

13. Should circumstances arise that are inconsistent with either Parties understanding of the intent of the chapter, the Southern Panel will discuss the matter postseason and explore options for taking the appropriate corrective actions.

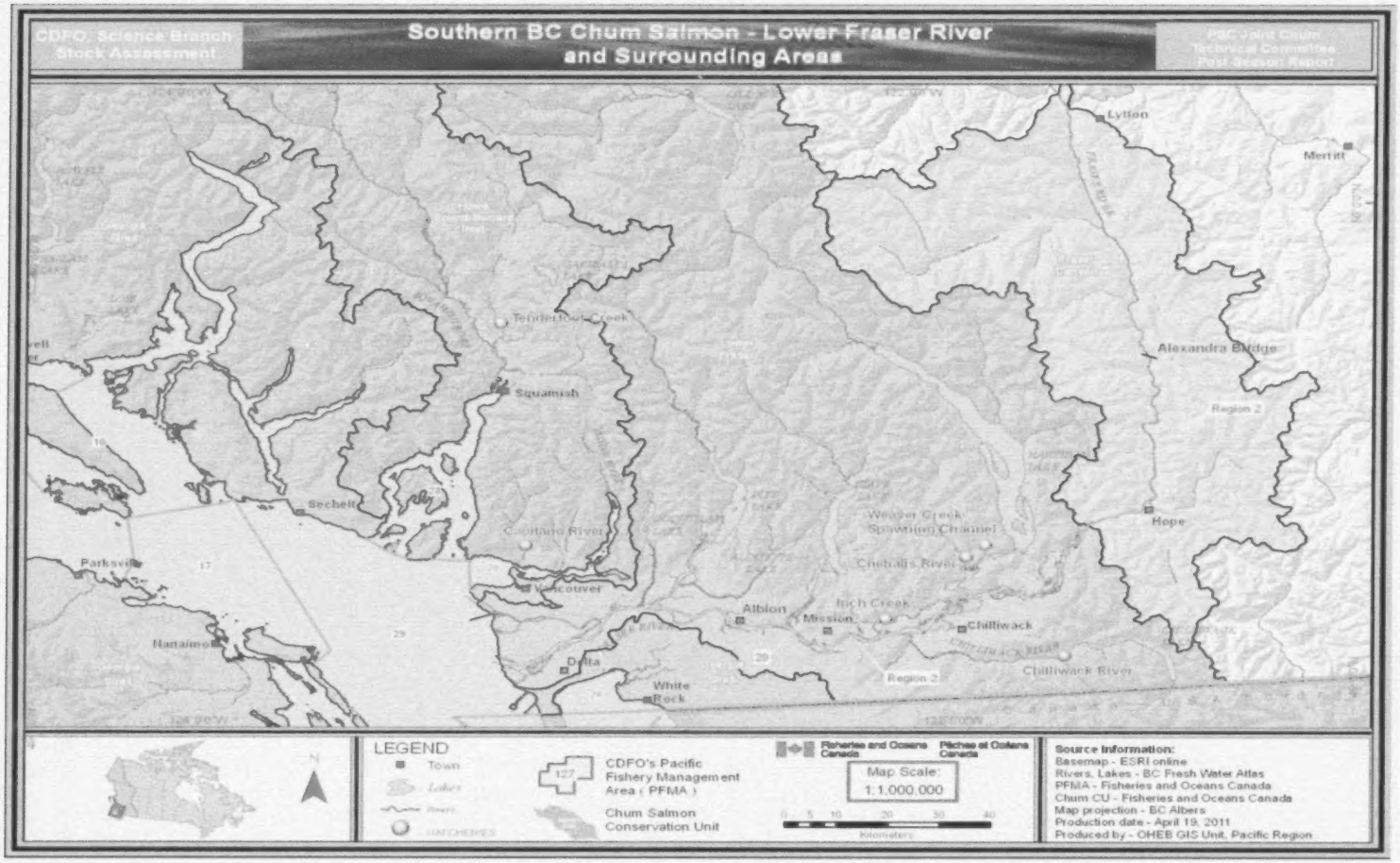
Appendix B-1. United States commercial salmon catch areas for the Strait of Juan de Fuca and Northern Puget Sound.



Appendix B-2. Canadian Pacific Fishery Management Areas (PFMA) for Southern B.C. - Marine areas.



Appendix B-3. Canadian Pacific Fishery Management Areas (PFMA) for Southern B.C. - Lower Fraser River and surrounding areas.



Appendix C. PSC Work Plan for the Joint Chum Technical Committee, 2012.

PSC CHUM TECHNICAL COMMITTEE WORK PLAN 2012

Post Season Meeting (January 2012)

Session Objectives:

1. 2010 Annual report
    a. Begin drafting of 2010 postseason report
    b. Make assignments leading to completion of report by end of PSC Annual Meeting in February.
2. Southern Chum Strategic Plan
    a. Review status of proposals submitted to SEF. Review proposal development process and discuss improvements needed, if any, for future submittals.
    b. Assigned leads to each possibleSEF proposal.
    c. Decide which US populations to use in the SNPs and MicroSAT baseline expansions
    d. NOAA mapping database need to continue filling in the sample database fields and update with new collections Need to review other funding sources to get the rest of the populations for the baseline
    e. Update progress in implementing Chum TC Strategic Plan and next steps
    f. Scope funding opportunities other than SEF that could help with implementing the strategic plan
        i. Database development
        ii. Escapement reference point development
3. Current southern chum status
    a. Review of this year's return relative to forecast and ocean conditions
    b. Update the 10-year chum status graph developed at the May 2011 workshop
4. Begin process of developing a long-term database of harvest and southern chum stock status
5. Chum TC business
    a. Plan for May 2012 meeting/workshop
    b. Location/date
    c. Agenda
    d. Non-member participants

Post Season Meeting (February 2012)

Session Objectives:

1. Focus on completion of the 2010 Chum Report.
2. Further planning work on SEF projects (confirmation on projects have been made)
3. Update strategic plan and develop next steps
4. Discussion on Southern Chum Assessment Framework
5. Update SEF funding priorities document for the Chum Chapter
6. Investigating database development for the ChumGEM model: Start to layout objectives, structure, inputs and outputs.
7. Finding other funding opportunities or resources to help with the database development, and other priority items such as the Escapement Reference Point development.
8. Completing a database of DNA samples collected in southern BC and WA

Bilateral PSC Chum Technical Committee Workshop (May 2012)

Session Objectives:

1. Update on existing SEF proposals
    a. Chum Workshop update (Amy and Kim)
    b. Fishery Sampling Update (Rebecca and Pieter)
    c. Baseline Augmentation and tool comparison (John and Mo)
2. Update on GAPS database options for Chum (John)
3. Brainstorm Chum GEM model structure (with external experts)
4. Review other model types and possible options
5. Determine initial startup costs and flesh out proposal for SEF
6. Discussion on additional items for Chum Tech report (Historical data appendices….)
7. Discussion of Southern Endowment Fund opportunities and priorities for next call for proposals
8. Assign leads for proposal development

Appendix D. Concept proposals (see work plans) submitted to Pacific Salmon Commission Southern Endowment Fund

Project Title: Joint US and CA Mixed-stock Chum Fisheries Sampling Design In order to facilitate management responses to Southern Chum stock strength, in accordance with Annex IV, Chapter 6 of the Pacific Salmon Treaty (Treaty) it is necessary to provide the catch composition in fisheries targeting Southern origin Chum populations. We are proposing to sample Southern BC and US mixed stock Chum fisheries to determine stock composition to the Canadian Conservation Unit (CU) and United States Management Unit (MU) level using genetic mixed stock analysis. In addition, run timing, distribution and diversion by CU and MU will be explored for run reconstruction. This proposal is informed by the results from the Southern fund project (Southern Study Area Chum stock distribution assessment in Washington and San Juan Island, Point Roberts and BC southern Gulf fisheries) that occurred 2007–2010. The goal is to sample the mixed stock Chum fisheries for four consecutive years in a multi-agency sampling effort.

Project Title: Chum Salmon Southern Area Genetic Baseline Enhancement This project enables the short- and long-term goals of the Joint Chum Technical Committee (Chum TC) to support the development, evaluation, and improvement of microsatellite and SNP data for identification of southern stocks in mixed-stock fisheries (page 3 of the Chum TC Joint Directions white paper, January, 2010). We propose an updated survey of genetic variation in representative population samples of Chum salmon from southern British Columbia (SBC) and Washington State (WA) to enhance the Chum salmon population genetic baseline for management and research. Tissue samples will be collected from representative stocks (roughly 30 stocks for initial evaluation) and genotyped at microsatellite (mSAT) and single nucleotide polymorphism (SNP) loci.

This study will enhance the existing mSAT baseline, particularly in the US, and thus will provide more accurate estimates in its present day use in international fishery estimates. This study will also enhance the existing SNP baseline to improve accuracy in international estimates. The enhanced SNP baseline will build on the panel currently being developed for Chum salmon originating from British Columbia and Washington in an ongoing project of UW and WDFW. The mSAT and SNP baselines will be compared for resolving power individually and in combination (concatenate data types) for mixed stock fishery and other fishery management questions through simulations and analyses of known and unknown mixed samples.

The primary application of these genetic data is resolving the stock composition of mixed stock fisheries. Genetic baselines will also be used to develop a new fisheries model that incorporates genetic and environmental information to manage fisheries. Other analyses could include relative reproductive success of hatchery and wild-origin spawners and the impact of supplementation programs, identifying origins of juvenile Chum salmon using coastal nursery

areas and address other management questions. The data set will also be evaluated for it utility in identification of southern stocks harvested in other areas, such as the Bering Sea trawl fishery.

Project Title: Chum Salmon Stock Identification and Assessment Workshop A first time Chum salmon workshop to include fisheries managers, field staff and geneticists to improve the application and integration of genetic stock identification (GSI), and improve the understanding of the importance of GSI baseline collection. The goal of the workshop is to facilitate interaction between the groups, improve cooperation and enhance information flow between all agencies. The PSC Chum Technical Committee has provided a consistent vision for future stock identification and long term management and this workshop is an important part of communicating that vision.

Appendix E. Southern B.C. and Washington Chum Salmon Tissue Inventory for GSI Analysis

Intial work began on a web-based program for keeping track of available tissue collections used for various GSI applications (Figure E.1). These sample collections are from southern British Columbia and Washington Chum salmon populations. For each collection information is added to a database such as: location, collecting agency, run time, sample size, status/storage information, and collection date. All these data can be queried and displayed on the map (Figure E.2). Please contact a Chum Technical Committee member for access to program.

Figure E.1 Screen short of map inventory of GSI tissue locations.